THURSDAY, MARCH 2, 1882

AMERICAN ANTS

The Honey Ants of the Garden of the Gods, and the Occident Ants of the American Plains. By Henry C. McCook, D.D. (Philadelphia: Lippincott and Co., 1882.)

LOOKING to the extensive and systematic work which Dr. McCook has already accomplished in the study of some of the most interesting species of New World ants, we are exceedingly glad to observe from this additional volume that he has now turned his serious attention to the honey ants, for, although the habits of this species were known to be certainly among the most remarkable of the many remarkable habits that are presented by the Hymenoptera, they have not hitherto engaged the study of any competent observer. As he himself observes, "Very little of their habits has heretofore been known, and only the forms of the honey-bearer and worker-major. In order, if possible, to remove this reproach from entomology, I started in the early part of July, A.D. 1879, for New Mexico."

In giving a short abstract of the results which have rewarded his energy, we may best begin by describing the forms or "castes" which Dr. McCook found to constitute a colony of honey ants. There are (1) three castes of workers, namely, major, minor, and minim or dwarf—the first being $8\frac{1}{2}$ mm. in length, the second 7 mm., and the third $5\frac{1}{2}$ mm. (2) Honey-bearers, "a sedentary class or caste distinguished by abdomens distended into a spherical form of expansion of the crop filled with grape sugar: the length (including abdomen) is 13 mm. (one-half inch); the proportions and description of the head and body are those of the worker-major, of which it may be a developed form." (3) Female, or queen—length 13 mm. (4) Male—length 5 mm.

Regarding the economy of the hive, the first important point established by Dr. McCook's observations is that the honey-bearers do not, as has been asserted, themselves elaborate the honey, but that this is gathered by the workers from a peculiar kind of vegetable gall, and by them poured into the crop or proventriculus of the honey-bearers; the honey-bearers are therefore nothing more than living store-houses for the food of the hive, their relation to the rest of the community being, as Dr. McCook observes, similar to that of the honey-comb cells to the hive bee. For not only do the worker-ants store the "rotunds," but when they require food they go to the rotunds, which feed them by pressing out a drop of their store from the œsophagus. Likewise "the queen, virgin females, males, and the teeming nursery of white grubs" are all dependent on the rotunds for nourishment. The honey is collected from the galls by the workers at night, the insects being very intolerant of sunlight, and quickly dying when exposed to it. The honey pressed from the body of the rotunds has a pleasant taste, somewhat resembling ordinary honey, but more aromatic, slightly acid, and contains a larger proportion of water—being, therefore, more limpid. It requires about 1000 honey-bearers to yield one pound weight (troy) of honey. Dr. Wetherill says, as the result of analysis, that the substance is "a nearly pure solution of grape-sugar which is in a state of hydration isomeric with grape-sugar, and differing from grape-sugar in not crystallising."

The working ants are so fond of the honey stored within the rotunds, that when, in making sections of the nests, Dr. McCook ruptured the abdomens of the rotunds, he always observed that, "notwithstanding the high state of excitement which pervaded the colony, the ordinary instinct to defend the nest and preserve the larvæ, cocoons, and other dependents, was at once suspended in the presence of the delicious temptation." It is therefore the more remarkable that when a rotund dies the workers do not open the abdomen to get at the contained honey, but, after severing the abdomen from the thorax, remove each part separately to a "cemetery," or common burying-ground which these ants, like many other species, maintain. The author suggests, and not improbably, that this forbearance on the part of the workers may be explained as "the result of an instinctive sentiment by which Nature guarantees protection to the living honey-bearer."

The partly-filled rotunds are not wholly dependent for their food upon the gorging process to which they are submitted by the workers, for when only partly filled, they will feed themselves on sugar; but the author never saw "a honey-bearer of full rotundity taking food or drink." But the fact that before this insect is largely distended with honey it will feed itself points to the supposition that it may be itself a worker, slightly, if at all modified in structure; and this supposition is borne out by anatomical investigation. For the latter has shown: (1) "that it is the *crop alone* which contains the nectar received at the mouth"; (2) "that the organs of the abdominal portion of the alimentary canal are ordinarily in a natural state, except in so far as their position has been changed by the downward and backward pressure of the expanding crop"; and (3) "that the process by which the rotundity of the honey-bearers has probably been produced has its exact counterpart in the ordinary distension of the crop in over-fed ants; that at least the condition of the alimentary canal in all the castes is the same, differing only in degree, and therefore the probability is very great that *the honey-bearer is simply a worker with an overgrown abdomen.*" "Why the extraordinarily distended crop seen in the honey-ant should be limited to two species (so far as known), and why so limited a number of workers in the formicaries of these two species should develop the round abdomen, are questions that provide sufficient wonder, but yield scant satisfaction."

The degree of distension which the crop of a fully-gorged rotund undergoes is certainly most surprising. Among the thirteen plates with which Dr. McCook's work is illustrated, several figures are given of the crop in various stages of repletion. In the comparative scale of representation adopted, the empty crop is drawn about the size of a pea, and the fully distended one about that of a tennis ball.

Regarding less special points of interest, we may notice the "absence of individual beneficence." Not a single instance of such beneficence was noticed, although closely watched for, while the exhibitions of an apparently cruel neglect were many. Thus, "the grains of sand and soil were heaped around the rotunds, until the poor creatures

were literally buried alive. It would have been easy for the busy masons to draw their fellows aside and thus carry on their work. But it either never occurred to them to do so, or the disposition was wanting." This, however, applies to the case when the ants are engaged in making a new nest after having been transferred *en masse* by the author to hitherto unbroken ground. But "in the natural sites the workers showed great interest in the preservation of the rotunds, dealing with them very much as with the larvæ." In these natural sites the rotunds hang suspended by their claws, backs downwards, from the roof of their underground chamber, and if they fall to the floor they are unable to move from the spot on account of their unwieldy mass. In such a case several workers "would join in removing one rotund pushing and pulling her along. . . . Another sketch represents a worker-major dragging a rotund honey-bearer up the perpendicular face of a cutting made in the excavation of the nest. The mandibles of the two insects were interlocked, and the worker *backed* up the steep, successfully drawing her *protégé*." It seems, however, to have been undetermined whether in such a case the worker restores the rotund to her place on the roof of the chamber; it is certain that they did not do so in the author's artificial formicaries, for although the fallen rotunds "were faithfully attended, often cleansed and caressed, in no single instance did the workers attempt to right them and restore them to the roof."

It will be seen from this brief epitome of Dr. McCook's results that, while adding a number of new facts, they partly confirm, and partly contradict the previously published statements of Llane (1832) and Wesmael (1838). But, as Dr. McCook himself observes, "One of the most perplexing accounts of the honey ant is that of Mr. Henry Edwards," who recorded the statements from a verbal description given to him by Capt. W. B. Fleeson, whose observations were made at or near Santa Fè. This description was first published in the *Proceedings* of the California Academy of Sciences (vol. v. p. 72, 1873), and afterwards in the columns of this journal. Its chief points were that the honey-bearing ants are suspended to the roof of this chamber by meshes of web, that there are three very distinct castes, if not species and genera of ants forming a colony, that the larger kind form a fortress of a most remarkable character, and also gather leaves and flowers which they deposit in the middle of their fortress, leaving them to be then conveyed by ants of a second species to the honey-bearers as food. The remarkable fortress was described as being formed in the shape of a perfect square, having one side open and always facing due south, while round the remaining three sides the ants of the larger species were described as perpetually parading in a double line of defence. None of these assertions have been corroborated by Dr. McCook, and therefore he may be excused for suggesting that Capt. Fleeson may perhaps have been "testing the credulity of the writer by one of those jokes of which naturalists are occasionally the victims." "But," he adds, "if the narrative is to be taken in good faith, I can only explain the facts by supposing that the observer happened upon a nest of cutting ants (*Atta fervens*) within whose boundaries a nest of Melliger had chanced to be established, and had confounded the habits of the two as those of one formicary; or, second, that the cutting ants, or some other species of a similar economy, has really acquired the habit of kidnapping and domesticating the honey-ant for the sake of its treasured sweets, precisely as many ants domesticate aphides." "The porterage of leaves, &c., into nests is not an uncommon habit among ants of divers species; therefore, without stopping to discuss the question whether such material may contribute to the food supply of the formicary, it may be remarked that its most probable and ordinary use is for purposes of architecture or nest-building."

After again reading the account as published by Mr. Edwards, we cannot entertain the suggestion that he has been the victim of an intentional hoax. But as the suggestion has been made by an honest and independent observer, we feel it to be incumbent on those who were responsible for the publication of the account to repudiate the insinuation of dishonesty; and, looking to the definite nature of the statements which that account contained, we feel it is now more desirable than ever that they should be either verified or disproved by some competent naturalist visiting the locality where the observations are said to have been made.

The second part of Dr. McCook's volume treats of the Occident Ants of the American Plains. These build mounds from less than half a foot to more than a foot in height, round which they make a circular "clearing" of grass and other vegetation, presumably by cutting it away after the manner of the agricultural ants of Texas, previously described by the same author. The mound is always covered with pebbles which have been removed in the process of excavating the underground chambers and galleries. Some of the pebbles so transported are ten times the weight of the ant, so that the labour performed would be paralleled by that of a man if he could carry half a ton up a staircase one-third of a mile high.

These ants do not begin their labour till eight or nine o'clock in the morning; so, as Dr. McCook seems not unwilling to observe, "it might not be unmeet that those persons whose love of sleep during late morning hours has been disturbed by the familiar Scripture proverb, 'Go to the ant, thou sluggard; consider her ways, and be wise!' should return upon their mentors with the above-recorded facts, and cite this ant, who is indeed no sluggard, as being nevertheless fond of a morning nap." The day's work, or at any rate the day of out-door work, begins by opening the gates which had been closed the previous evening. "The manner of opening the gate cannot be fully described, because the work is chiefly done within and behind the outer door of gravel. The mode would doubtless be correctly indicated by reversing the process of closing gates, presently described. What I saw was, first, the appearance of the quivering pair of antennæ above one of the pebbles, followed quickly by the brown head and feet projected through the interstices or joints of the contingent gravel-stones. Then forth issues a single worker, who peeps to this side and that, and after compassing a little circuit round about the gate, or perhaps without further ceremony, seizes a pebble, bears it off, deposits it a few inches from the gate, and returns to repeat the task; she is followed, sometimes cautiously and at intervals of ten, twenty, even thirty minutes, by a few other ants, who aid in clearing away

the barricade, after which the general exit occurs. Again there is a rush of workers almost immediately after the first break, who usually spread over the hill, bustling around the gate, gradually widening the circles, and finally push out into the surrounding herbage. At first the exit hole is the size of a pea, perfectly round, and plainly shows that sand and soil have been used under the gravel to seal up the gate. The whole appeared to have been cemented, probably by the moisture of the night dew.

"The process of closing the gates is even more interesting to the observer than the opening, as the various steps are more under his notice. . . . At nest A the closing was chiefly from within. The workers pushed the sand from the inside outwards with their heads. A grass straw about an inch long was brought from the interior and pushed out until it lay across the gate as a stay for the filling material. Soil was here principally used for closing, a few pebbles being added." In another case, "when the gate was nearly closed a straggling minor came back from the commons and essayed entrance, wherein she failed. Several trials and failures succeeded, whereupon she commenced dragging the dirt from the opening. While thus engaged the major approached with a huge bit of gravel, which she deposited on her comrade with as much nonchalance as though she were one of the adjoining pebbles. At last the minor dug out a tiny hole through which she squeezed into the nest, and the major, who was deliberately approaching close behind her, carrying another pebble, immediately sealed up the opening. During this amusing episode the straggler made no effort to aid in the closing, being wholly intent on entering, and the gate-closer paid no attention to her whatever, beyond the first sudden and satisfactory antennal challenge. Each moved forward to her own duty with the undisturbed plasticity of a machine."

This "by-play" between the gate-closers and the late-returning foragers is not the exception but the rule; nevertheless it does not appear that the foragers ever so far miscalculate their time as to arrive after the gates are completely closed. When the gates are all but closed there is generally but a single ant engaged in the closing process from without; this ant slips in at the last moment, and the process is finally concluded from within. The gates are similarly shut during the day-time if the weather seems to threaten a heavy rain-storm.

In disposition the Occident Ants, though provided with very formidable stings, are exceedingly mild and unwarlike—so much so, indeed, that even when greatly incommoded by the tiny but viscous erratic ants which Dr. McCook observed on one occasion to have impertinently established a nest within their "clearing," they would not dislodge or even fight their insignificant foes, but "entirely abandoned their old avenue, cut down and around the erratic colony, and made an opening on the edge of a slight ridge several inches beyond the disputed territory, but still in the line of the avenue which they had been using in their work. A tithe of the pains required for this task would have literally cut out and carried away the whole nest space of the erratics, whose scant numbers of diminutive warriors could have been overwhelmed in a moment by the legions of their huge hosts."

Lastly, Dr. McCook has satisfactorily ascertained that these Occident Ants present the same habits of "harvesting" as those which were previously known to occur in the allied species of Florida and Texas. His work as a whole deserves warm commendation, and we trust that the success which has attended his study of the sundry species of ants that have hitherto engaged his attention, will induce him to extend his researches to those other species on the American continent which present habits and instincts, if possible, more remarkable than those which he has done so much to elucidate.

GEORGE J. ROMANES

OUR BOOK SHELF

The Story of our Museum, showing how we Formed it, and what it Taught us. By the Rev. Henry Housman, A.K.C., &c., &c. (London: Society for Promoting Christian Knowledge, 1881.)

THIS is a most excellent book for a boy with a taste for natural history. It describes in a pleasing and natural way how two boys living in a country village in Gloucestershire began to make a museum. It narrates all their difficulties, their failures, and their successes; and how, by perseverance, and with very little expense, they gradually formed a collection illustrating the whole range of the natural history and antiquities of their district, including, besides, postage-stamps and autographs. How much pleasure and how much knowledge are to be obtained while forming such a collection is very well shown; and though there is little novelty in the book, occasional diffuseness in the treatment, and hardly any passages that will bear separate quotation, these trifling deficiencies do not at all detract from its merit as a book for boys, which is all that it pretends to be.

The one decided innovation on the almost universal practice of collectors is, the strong recommendation of a natural system of mounting butterflies and moths. The usual mode of exhibiting the lepidoptera, all set out with expanded wings on one horizontal plane, is objected to as being monotonous and completely false to nature. Of course in an extensive systematic collection this method is absolutely necessary, for classification, easy reference, comparison, and critical examination; but in forming a purely local collection, the superior advantage of the natural system of mounting are strongly advocated, at least for the butterflies and all the larger moths. These should be exhibited sitting or flying, with the wings elevated or depressed, as if alive, and the legs and antennæ placed in natural positions. Of course this requires glass cases for these insects as for birds; but when the collection is restricted this is no objection; and by exhibiting the preserved larvæ, eggs, and pupæ, along with the perfect insects in all their different natural attitudes, it is maintained that much more instruction will be afforded, while the effect will be far more picturesque and pleasing than the straight rows of unnaturally expanded insects can ever be.

The only other part of this volume calling for further notice here, is an appendix, "On the Arrangement of Natural History Collections," in which the more natural and attractive arrangement of the galleries of public museums is strongly advocated. As regards the higher animals, there is nothing fresh in these recommendations; but the author also urges the exhibition of complete series of such fossil species as illustrate the persistence of types or the development of forms throughout considerable geological periods. This, however, is never done in our great public museums. In the case of living animals the species are exhibited in systematic groups, while no attempt is made to show the equally interesting geographical grouping; while with extinct animals an opposite

mode is followed, and all are arranged stratigraphically, without any attempt to show the more interesting developmental or time-series. Thus, in both cases the most interesting and instructive methods of arrangement are entirely neglected in favour of systems which are adapted solely to facilitate study by specialists, but which are comparatively unimportant and uninteresting to the public. Even to this day it does not seem to be realised by curators of museums, that the collections for study and those for public exhibition require to be arranged upon totally distinct plans; and that the method which is the very best in the one case may be, and usually is the very worst in the other. ALFRED R. WALLACE

Geology of the Counties of England and of North and South Wales. By W. Jerome Harrison, F.G.S. (London: Kelly and Co., 1882.)

ALL who have had occasion to use the valuable Post Office Directories of the English counties published by Messrs. Kelly and Co., will have noticed that the imperfect notes on geology contained in former editions have now been replaced by very accurate and well-written articles on the subject. These notes on the geology of the English counties have been drawn up, evidently with much skill and labour, by Mr. W. J. Harrison. In each case the scattered maps and publications of the Geological Survey have been very carefully studied, and the various memoirs and notices on the geology of each of the counties contained in miscellaneous journals and magazines faithfully summarised. The result is that the numerous readers of those widely diffused publications, the County Directories, have at hand a reliable sketch of the geology of the district in which they live, carefully brought down to the date of publication. What is perhaps of still greater importance is, that these sketches include references to all the principal works bearing on the subject, so that the reader is told where he may find fuller and more detailed information upon any point in which he may be interested. We can scarcely conceive a method by which useful geological information could be more widely diffused, or made more easily available for those who wish to obtain correct ideas concerning the geology of the district in which they live. These sketches of the Geology of the English Counties have now been collected into a volume, and constitute a very useful work of reference. We have tested it in many ways, and find that in almost every case the latest information, even when published in journals of very restricted circulation, has been discovered and made use of. Mr. Harrison's essays are clearly written, and each of them is preceded by a list of the local Natural-History and Scientific Societies, the members of which collect information bearing on the geology of the county; of the museums in which rocks and fossils from the county are preserved; of the publications of the Geological Survey bearing on the county; and of such other works as in any way refer to the subject. In all cases where he was in doubt Mr. Harrison appears to have sought the assistance of competent authorities, the result being a work which is exact, and at the same time is written in a popular style. There are numerous excellent woodcuts, most of which appear to be taken by permission from the publications of the Geological Survey and the Geological Society. We can heartily recommend this book as a convenient and reliable work of reference.

University College Course of Practical Exercises in Physiology. By J. Burdon Sanderson, M.D., LL.D., F.R.S., with the Co-operation of F. J. M. Page, B.Sc., F.C.S., W. North, B.A., F.C.S., and Aug. Waller, M.D. 8vo, pp. 75. (London: H. K. Lewis, 1882.)

THIS book is a *multum in parvo.* It gives in a most condensed and yet most clear and precise form, an account of the method of performing the most important experiments in physiology. It will be useful not only to students, but to practitioners who wish, with a small expenditure of time and labour, to become acquainted with the present state of our information, and the most important points in physiology, and the experimental data on which our knowledge rests. The exercises relating to the physiology of muscle and nerve are especially worthy of commendation. They make clear to the student the different arrangements of electrical apparatus, the comprehension of which is to many an insuperable difficulty, not only during their student's career, but during the whole of their lives. The few and simple diagrams in the text are just what were wanted to make the experiments readily understood. Half an hour spent with this little work will, we think, give to the beginner a better grasp of the subject of which it treats than days spent over more elaborate text-books, however good the latter may be for advanced students.

Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux 2e série, tome iv. 2e cahier. (Bordeaux: 1881.)

WE draw attention to this number specially for the benefit of such as are interested in the early history of arithmetic. It contains (pp. 161-194) an able paper by M. Paul Tannery (who is known by his previous similar work upon the "Collection Mathématique" of Pappus in tome iii. pp. 351, &c., of these same *Mémoires*) on "l'Arithmétique des Grecs dans Héron d'Alexandrie." He goes carefully into the question of the authenticity of the several so-called Heronian writings, and analyses those which he accepts, and concludes with one or two specimens of the approximate methods employed. We need only mention the names of Cantor, Martin, Hultsch, and Rodet as being those of the authors whose works and statements are discussed. Other papers are: M. Hautreux, "Etudes météorologiques de la Gironde à la Plata"; M. Millardet, "Pourridié et Phylloxera; étude comparative de ces deux maladies de la vigne"; M. Royer, "Récherches sur le passage du mercure à travers les liquides"; and M. Ponsot, "De la reconstitution et du greffage des vignes." From this enumeration it will be seen that some of the papers are of a very practical character, touching the interests of the commonalty. M. Debrun contributes a short note (and illustration), "Sur un nouveau baromètre amplificateur."

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Hypothetical High Tides

I SHOULD like to be allowed to ask two questions on this subject: First. Could the vegetable accumulations from which the coal has resulted have escaped destruction if, during their subsidence, the world was subject to such tides as Mr. Ball postulates? It is difficult to understand how this could be if the shales and sandstones which overlie the coal be of marine or estuarine origin. Second. What do the Palæozoic conglomerates disclose on the subject? The shingle of beaches heaped up by the tide, having each layer of sand and pebble laid at the slope of the beach face, exhibits when cut at right angles to the trend of the beach the continuously oblique bedding which represents this slope, the vertical heights of the shingle bed thus laid up representing the extreme rise and fall of the tide and surges. This may be seen in the case of the Lower Eocene shingle in Bickley Cutting of the Dover Railway and in the case of the early Glacial shingle in deep pits at Henham and Halesworth in Suffolk. The latter show a tidal rise and fall there of more than twenty-five feet, the former not so much. The same structure obtains in the case of sandbanks left dry by the tide, and of such

nearly all the Red Crag consists, the oblique layers of sand and shell corresponding to the oblique layers of sand and shingle in beaches. I have seen this structure extending for some distance in a railway cutting through Jurassic sandstone, but there was nothing to indicate that the tidal slope under which it was formed was greater than in the case of the Crag. It may be otherwise for aught I know with the old conglomerates, for I am not acquainted with them.

S. V. WOOD

DR. CALLAWAY points out that there would be nothing in the nature of the older deposits to indicate the existence of excessive tidal action. One point, however, suggests itself to me in connection with the increased force of winds and currents, which must necessarily have accompanied the high tides and more rapid rotation of earlier epochs.

While the general nature of the Palæozoic strata indicates that they were deposited along the margins of continental or insular masses of land, there is a remarkable absence of estuarine conditions in the older Palæozoic rocks. Indeed, except in some portions of the Carboniferous deposits, in which beds of coal occur together with such marine species as Goniatites and Aviculopecten, there seem to be no beds of Palæozoic age which can with certainty be referred to an estuarine origin. The earliest plant-remains, such as *Eophyton*, from the Fucoidal sandstone of Sweden, are probably marine algæ, which currents might transport to great distances from land.

Now considering the frequency with which delta deposits occur in Neozoic strata, the almost entire absence of them during the immense earlier periods is a fact which seems to require some explanation.

Now it seems highly probable that excessive tides would have disturbed even inland seas (if any existed at that time) which are most favourable for the accumulation of deltas, and that strong marine currents would scour out even those sheltered estuaries, which, with moderate tides, would have been, like those now existing in the Mediterranean, comparatively free from tidal action. The delta of the Ganges is nearly the only instance of a great river delta forming in spite of tidal fluctuations; but, although the average height of the tide here seldom exceeds 10 feet, even this moderate amount is sufficient to prevent the delta from pushing its way far out to sea.

Another point which must not be lost sight of, in considering the influence of stronger oceanic currents, is the greater distance to which the coarser materials might be carried out to sea; so that it would not necessarily follow that those deposits, which we are accustomed to regard as evidence of the proximity of land, are of littoral origin. For with strong currents, even coarse grits and conglomerates might be widely distributed over the ocean floor.

J. VINCENT ELSDEN

Storrington, February 25

Palæolithic Man and Löss

I HAVE just been reading Geikie's "Prehistoric Europe," and am much interested by his digest of Dr. Nehring's discovery at Thiede and Westeregeln. At p. 150 it is stated that "the lower beds at Westeregeln have yielded traces of man such as flint flakes, charred wood, and heaps of smashed and crushed bones of various animals." And further on, "that they could not have come from any distance, an inference which is in keeping with the generally unrolled character of the stones and the state of preservation of the fragments of wood." At p. 151 he describes another interesting find by Count Wurmbrand near Zeiselberg. "At that place the undisturbed löss yielded a rich deposit of bones underneath which occurred a blackish stratum abounding with fragments of charcoal and worked flints." From the general appearance presented by the human relics and animal remains (mammoth, rhinoceros, reindeer, &c.) "it was evident that they could not have been transported from any distance."

An idea seems to be conveyed here that the remains in both cases had been carried by water and redeposited, but it appears to me that they have been found just where Palæolithic man left them. From the experience gained by eleven or twelve years' study of the sand-hills round the northern coast of Ireland and the finding of blackish layers containing flint flakes, implements, and broken bones of Neolithic age, I believe Dr. Nehring and Count Wurmbrand have hit on old land surfaces on which Palæolithic man lived; that the fragmentary bones have been scattered about by him after using the flesh for food; and that the unrolled stones can be accounted for by supposing that he carried them to the spots where they were found.

The blackish layers in the sand-hills of the Irish coast, which I have found to contain flint flakes and implements, are covered with a great thickness of sand, and I have on several occasions expressed my opinion that this covering was accumulated slowly, first by the wind depositing the sand, and secondly by the grass retaining what it could shelter, the increase in thickness being dependent on the rapidity of vegetable growth. I first stated my views on this subject at the Belfast meeting of the British Association in 1874, and since in several published papers (see *Journal* of the Anthropological Institute, vol. vii. No. 3, and ix. No. 3; *Proceedings* Royal Irish Academy, 2nd series, vol. ii. No. 3). All the evidence given by Sir Charles Lyell in "The Antiquity of Man," and by Dr. Geikie in "Prehistoric Europe," in reference to loess (löss) clearly points to its being in its present condition an accumulation also produced by the joint agencies of wind and vegetation, and I have no doubt, from reading of Dr. Nehring's and Count Wurmbrand's finds, that during the slow and steady growth of the löss, many Palæolithic land surfaces and sites of camps or dwellings may have been buried up, and may now occasionally be found in an undisturbed state. Newer surfaces with included remains may also be found higher up, as in every stage the valleys would be the most desirable places to live in.

At p. 165 Dr. Geikie mentions a theory advanced by Baron Richthofen as to the formation of löss in China. I express no opinion as to the first production of the fine material, but as to its deposition by the wind afterwards, I believe he was on the right track. In the case of the sand-hills I have studied, the portions covered by grass are still becoming higher. Would it not be interesting to find out if the löss, in any protected part, is also increasing in thickness at the present time?

Cullybackey, Belfast, February 18

W. J. KNOWLES

Pronunciation of Deaf Mutes who have been Taught to Speak

THE letter of Prof. A. Graham Bell in NATURE (vol. xxv. p. 124) is hardly conclusive of the matter. The evidence he adduces, though exceedingly valuable, is chiefly of a negative character.

M. Hément states as a matter of his own personal observation, that deaf-mutes who have been taught to speak, do so with the accent of their native district. M. Blanchard denies this because, according to him, the pronunciation of deaf-mutes does not possess that quality of accent distinguishing human voices. Mr. Bell agrees with the conclusion at which M. Blanchard has arrived, but denies the data on which the conclusion is based. Mr. Bell, in an examination of at least 400 deaf-mutes, has never noticed the tendency observed by M. Hément. "It is true," he adds, "that in a few cases dialectic (? dialectal) pronunciations are heard, but it always turns out upon investigation that such children could talk before they became deaf. The peculiarity is undoubtedly due to the unconscious recollection of former speech, and cannot correctly be attributed to heredity." M. Hément, however, reaffirms the accuracy of his own observations, and declares himself unable to conceive how in losing the case of speech, deaf-mutes should retain the unconscious memory of accent.

Prof. Graham Bell's theory will certainly not explain the case of Daniel Fraser, referred to in my previous letter, who is expressly stated to have "continued deaf and dumb from his birth till the seventeenth year of his age (*Philosophical Transactions*, No. 312). This case is all the more striking since the narrator mentions his inheritance of the Highland accent in a purely incidental manner.

I am fully aware of the weight to be attached to the evidence of an observer so able, precise, and accurate as Prof. Graham Bell, but that he has *not* noticed the peculiarity in question can hardly be held to invalidate the independent testimony of those who, in Paris, Madrid, and Inverness, declare that they have observed it. For my part I see no reason to doubt either their accuracy or their good faith.

E. A. AXON

Manchester

P.S.—It may be worth noting that the full discussion of the subject has appeared in the *Comptes rendus*, the current volume of which contains three notes by M. Hément, one by M. Blanchard, one by Mr. Bell, and one by the present writer.

A Strange Phenomenon

On February 18 this part of Scotland was visited by a furious gale of wind, rain, sleet, and hail. The gale subsided considerably about five o'clock in the afternoon. At eight o'clock the sky was fairly clear, when a black cloud sprang up in the north, and the night became suddenly intensely dark. With the darkness came a tremendous shower of hail. All at once I was startled by a vivid flash of lightning close at hand, but without thunder. At the same instant I found myself enveloped in a sheet of pale flickering white light. It seemed to proceed from every part of my clothes, especially on the side least exposed to the hail, and more particularly and brightly from my arm, shoulder, and head. Though I turned about pretty smartly, and shifted my position, I found it impossible to shake off the flickering flames. When I walked on they continued with me for two or three minutes, disappearing only when the violence of the blast was somewhat diminished. I felt no unusual sensation beyond the stinging of the hail, and no sound except that of the storm. Then and since I have puzzled myself to account for the strange phenomenon, and can only imagine it to have been a peculiar manifestation of St. Elmo's Fire, so well known to sailors during thunderstorms within the Tropics. Some of your readers may, perhaps, be able to give instances of a similar occurrence, unique both in my experience and reading.

James Moir

Schoolhouse, Savoch, Ellon, Aberdeenshire, N.B., Feb. 12

Intelligence in Birds

As it appears to me that in the correspondence to Nature on this subject no instance has been given of reasoning power in birds, more notable than that afforded by Miss Bird in "Unbeaten Tracks in Japan," I venture to submit the following quotation. X.

February 15

"I have not said anything about the crows, which are a feature of Yezo, and one which the colonists would willingly dispense with. There are millions of them, and in many places they break the silence of the silent land with a Babel of noisy discords. They are everywhere, and have attained a degree of most unpardonable impertinence, mingled with a cunning and sagacity which almost put them on a level with man in some circumstances. Five of them were so impudent as to alight on two of my horses, and so be ferried across the Yurapugawa. In the inn-garden at Mori I saw a dog eating a piece of carrion in the presence of several of these covetous birds. They evidently said a good deal to each other on the subject, and now and then one or two of them tried to pull the meat away from him, which he resented. At last a big strong crow succeeded in tearing off a piece, with which he returned to the pine where the others were congregated, and after much earnest speech they all surrounded the dog, and the leading bird dexterously dropped the small piece of meat within reach of his mouth, when he immediately snapped at it, letting go the big piece unwisely for a second, on which two of the crows flew away with it to the pine, and with much fluttering and hilarity they all ate, or rather gorged it, the deceived dog looking vacant and bewildered for a moment, after which he sat under the tree and barked at them inanely. A gentleman told me that he saw a dog holding a piece of meat in like manner in the presence of three crows, which also vainly tried to tear it from him, and after a consultation they separated, two going as near as they dared to the meat, while the third gave the tail a bite sharp enough to make the dog turn round with a squeal, on which the other villains seized the meat, and the three fed triumphantly upon it on the top of a wall. In many places they are so aggressive as to destroy crops, unless they are protected by netting. They assemble on the sore backs of horses and pick them into holes, and are mischievous in many ways. They are very late in going to roost, and are early astir in the morning, and are so bold that they often came 'with many a stately flirt and flutter' into the verandah where I was sitting. I never watched an assemblage of them for any length of time without being convinced that there was a Nestor among them to lead their movements. Along the seashore they are very amusing, for they 'take the air' in the evening, seated on sandbanks facing the wind, with their mouths open. They are threatening to devour the settlers, and a crusade is just now being waged against them, but their name is Legion." ("Unbeaten Tracks in Japan," vol. ii. p. 149.)

A System of Meteorological Observations in the China Seas

In Nature (vol. xxv. p. 368) you give information about a system of observations and storm-warnings about to be started in the China seas. The scheme itself is excellent, and the choice of Zi-ka-wei (not Siccawei) is also good, only I may express a doubt as to the success of the storm-warnings till a greater area is included. As to the *winter-storms*, some stations in the north-west of China are necessary, and even Kiakhta and Irkutsk would be more useful than Vladivostok, for example, as depressions coming from the west will be earlier felt there than in China. As to the *typhoons*, as they certainly originate east from China, and first travel to the west, telegraphic warnings from Formosa and the Liu-kiu islands would be necessary, otherwise they are apt to reach the coast of China too suddenly. With a chain of stations on these islands between China and Japan it would be possible to observe typhoons at or very near to their origin, to follow them step by step, and save an immense quantity of life and property. A telegraph line uniting these islands to China and Japan is certainly a large undertaking, but as the Japanese will derive great benefit from it, they will probably take part of the expenses. A. Woeikof

St. Petersburg, February 23

New Red Star

The following is a rather noteworthy case of fine red colour in a very small star. It was observed February 7 and 8 as follows:—

R.A. 4h. 59m. 41s.; Dec. $-22°\ 3'$ (1880) mag. 9·5.

It is 29′ north and 41s. west of ϵ Leporis.

Edward S. Holden

Washburn Observatory, University of Wisconsin, Madison, Wisconsin, February 8

Purification of Sewage

In the purification of sewage by the methods of irrigation and filtration it is said that filtration through a depth of ten inches of soil suffices to get rid of the phosphates, may I ask if it is known through what depth of soil it is necessary to filter to eliminate the nitrates? X.

February 14

THE INTERNATIONAL FISHERIES EXHIBITION

At last the great International Fisheries Exhibition, to be held in London, and to which we have occasionally referred during the past few months, has taken definite shape. The influential meeting which was held on Monday under the presidency of the Prince of Wales, gives promise that the Exhibition will be one of the most interesting and practically important which have been held in the country. The Berlin exhibition last year was a brilliant success, and the Norwich Exhibition of last spring did much good. Her Majesty the Queen has bestowed her name as patron on the proposed Exhibition; the Prince of Wales is president, and on the long list of Vice-presidents are many nobles, politicians of both parties, well-known representatives of science, and men eminent in various departments. Of the General Committee, the Duke of Richmond is Chairman, and on it are such names as those of Prof. Huxley, Mr. Spencer Walpole, Mr. Francis Francis; while among the Vice-presidents are the names of Mr. W. Spottiswoode, P.R.S., Dr. Günther, Sir John Lubbock, Mr. Mundella. Thus it will be seen that science is amply represented, and especially the science of the subject; and it is fortunate that we have at present as one of H.M. Inspectors of Fisheries so eminent a representative of science as Prof. Huxley.

The project of holding an International Fisheries Exhibition in London is, in a great measure, the result of the success of the National Fisheries Exhibition held in April, 1881, at Norwich, under the patronage of H.R.H.

the Prince of Wales, and under State recognition, with the co-operation of the Worshipful Company of Fishmongers. At a private meeting held in July, 1881, it was determined by a few leading gentlemen, interested in the welfare of the great fishing industries, to follow up the National Fisheries Exhibition at Norwich by calling a public meeting in order to discuss the desirability of holding an International Fisheries Exhibition in London in 1883. A meeting was accordingly held at Fishmongers' Hall in August, 1881, under the presidency of the Marquis of Exeter, and Resolutions were unanimously passed approving the idea as likely to be of the greatest benefit and importance to fishing industries throughout the world. A General and Executive Committee were then formed, and great progress has since been made in preliminary arrangements.

The Committee, we are assured, have bestowed long and anxious consideration on the prospectus of the proposed Exhibition. The classification, which has been compiled with the assistance of leading scientific men, comprises every object adapted for exhibition, illustrative of Sea and Fresh Water Fisheries; the preparation, preservation, and utilisation of Fish; Fish Culture; the Natural History of Fish, and Literature connected with Fishing. It is proposed to give prizes on important subjects connected with fishing; and, with a view of turning the Exhibition to practical account, conferences are to be held for the purpose of reading and discussing subjects specially connected with the fishing industries. The Exhibition is to be opened on the 1st of May, 1883. In order to illustrate the great extent and magnitude of the fishing industries of the United Kingdom, it may be stated that, at the lowest calculation, 550,000 tons of fish are annually taken in British waters by our own fishermen; that, according to Professor Huxley, 3,000,000,000 herrings are annually taken in the North Sea alone; that 130,629 tons of fish were delivered in Billingsgate Market in one year; and that the fisheries of the United Kingdom are carried on by about 35,000 boats and vessels, giving employment to no less than 110,000 people afloat.

To carry out the proposed Exhibition on an adequate scale, it is proposed to open immediately a subscription list for the general and prize fund, and also a subscription list for a guarantee fund, to provide against contingent liabilities in the event of the proceeds of the Exhibition proving insufficient to meet the expenditure. The Fishmongers Company have already promised the sum of 500*l.* for the general and prize fund, and 2,000*l.* to the guarantee fund.

The Exhibition will be divided into seven classes, each with many subdivisions:—I. Fishing, in two sections, Sea Fishing and Freshwater Fishing; II. Economic Condition of Fishermen; III. Commercial and Economic; IV. Fish Culture, which will include sections devoted to Scientific Investigation and Acclimatisation of Fish; V. Natural History under the following departments:—1. Specimens living (marine and fresh water), fresh, stuffed or preserved, casts, drawings and representations of—(*a*) Algæ arranged according to their various species and localities; (*b*) Sponges, in their natural state; (*c*) Corals, in their natural state, polyps, jelly-fish, &c.; (*d*) Entozoa; (*e*) Mollusca of all kinds and shells not included in class III.; (*f*) Starfishes, sea urchins, holothuriæ; (*g*) Worms used for bait, or noxious; leeches, &c.; (*h*) Perfect insects and larvæ of insects, which are destroyers of spawn or serve as food for fish; (*i*) Crustacea of all kinds; (*k*) Fish of all kinds; (*l*) Reptiles, such as tortoises, turtles, terrapins, lizards, serpents, frogs, newts, &c.; (*m*) Aquatic and other birds hostile to fish or fishing; (*n*) Aquatic and amphibious mammalia (otters, seals, whales, &c.) and others detrimental to fish. 2. Works on Ichthyology. Maps illustrating geographical distribution, migration, &c., of fishes and spawn. 3. Specimens and representations illustrative of the relations between extinct and existing fishes. VI. History and literature of fishing, fishing laws, fish commerce. VII. Loan collections. This certainly seems comprehensive enough.

According to a preliminary notice Prizes of 100*l.* will be given for each of the following subjects, viz.:—1. The natural history of commercial fishes of Great Britain, with especial reference to such parts of their natural history as bear upon their production and commercial use. 2. Relations of the state with fishermen and fisheries, including all matters dealing with their production, regulations, &c. 3. On the possible increase of the supply of fish, and on improved facilities for their economic transmission and distribution.

All the speakers at Willis's Rooms on Monday seemed duly impressed with the importance of the Exhibition; and it was evident from their speeches that the Prince of Wales and Duke of Edinburgh take a genuine and intelligent interest in the matter. The statistical and economical sides of the proposed Exhibition were naturally more prominent before the meeting than the scientific, though the composition of the committee is a guarantee that the latter will have full attention. The Prince of Wales's reference to Prof. Huxley, and the plan of exhibits given above, may be taken as significant that these will not be neglected. There is plenty of time to make all arrangements and find a proper *locale*, and, probably enough, the committee may find it necessary to make some modifications in their arrangements. We are glad to see that the Prince of Wales is acquainted with the important work in fish-culture which is being done in the United States, which, we trust, will be fully represented at the Exhibition.

It may be useful to our readers to know that the offices of the Exhibition are at 24, Haymarket.

THE CHEMISTRY OF THE ATLANTIC[1]

II.

IN considering the effect of depth on the gaseous contents of sea water, Dr. Tornoe arranges his results in groups, giving the mean percentage of oxygen in different intervals of depth. From the consideration of this table he concludes that "the proportion of oxygen, which at the surface is 35·3 per cent., begins at once and continues to diminish, at first rapidly and afterwards at a slower rate, till it has reached 32·5 per cent. at the depth of 300 fathoms, from whence it keeps almost constant. I will not omit, however, to observe that of the samples of water examined, forty had been drawn from the bottom; it was, however, impossible to detect any difference in composition between these and the samples obtained from equal intermediate depths."

The results of the analysis of the *Challenger* samples pointed to a very decided minimum of oxygen occurring about 300 fathoms from the surface. The observations on which this conclusion depended were the analyses of the gases from two samples of water from 300 fathoms in the region of equatorial calms in the Atlantic. The temperature of the water was 7·0° C. and 6·8° C., and the oxygen percentages 10·75 and 11·98. The nearest part of the ocean where a surface temperature of 7° C. occurs at any time of the year is more than 2000 miles distant, so that the water in this position must necessarily have been shut out from a fresh supply of oxygen for a long time while continually exposed to the reducing action of live and dead animal matter. In the Arctic waters explored by the Norwegian Expedition there must be a tolerably thorough equalisation of temperature from surface to bottom every winter, producing a renewal of the atmospheric contents of the water, consequently it is not surprising that the

[1] The Norwegian North Atlantic Expedition, 1876-78. Chemistry. By Hercules Tornoe. (Christiania: Grœndal and Son, 1880.) Continued from p. 389.

differences observed both by the Norwegian Expedition and by Jacobsen in the aëration of water from different depths are so slight. Indeed, the *Challenger* analyses show exactly the same result for Antarctic waters. As the amount of nitrogen is probably not exposed to diminution, it may be taken as an indication of the temperature at which the water was last exposed to the air, and may therefore be used as a check on the depth from which the water has been brought, more especially in tropical regions, where the temperature at the surface is very different from what it is either at the bottom or intermediate depths. For this purpose, however, we require more observations on the absorption of atmospheric gases by sea water, especially at low temperatures; and, further, any conclusions drawn must be inaccurate, in so far as we do not know the barometric pressure of the atmosphere to which the water has been exposed. This is a very important element, for the water at the surface of the Antarctic Ocean is exposed to a much lower mean barometric pressure than at any other part of the globe, whether Arctic, Temperate, or Tropical, consequently a carefully-made determination of the nitrogen in a bottom water would, when taken in connection with the temperature, indicate whether it came from Arctic or Antarctic sources. This difference would certainly amount to 1 cc. per litre, which could easily be determined with careful work.

The great value of the results obtained by Dr. Tornoe in this department of his work make it all the more to be regretted that through mechanical mishaps so many samples, involving much time and work, should have been lost.

The form in which the results are presented to the reader might be improved by the addition of one or two columns to the table. It includes the analyses of samples collected in the three summers, 1876, 1877, and 1878, and it would have been more useful to the reader to have found the date of collection in the first column than a series of consecutive numbers. The second column is the "Station No.," and it is important as facilitating reference to other results obtained at the same place. By its means the writer was enabled to refer to Prof. Mohn's papers in *Petermann's Mittheilungen*, and from them to supply a column giving the depth of the sea at the station. The omission of this information from the table made it impossible to distinguish between bottom water and water from intermediate depths. Another column might also with advantage have been added, giving the volume of oxygen in cubic centimetres per litre.

In the second chapter of the work Dr. Tornoe treats of the carbonic acid dissolved in sea-water, and here also he adds very materially to our knowledge. The first reliable information on the subject was obtained by Jacobsen on board the *Pomerania*. He rejected the gasometric method, having recognised the uncertainty which attached to the elimination of the carbonic acid from sea water by boiling under reduced pressure and adopted the method of determining the carbonic acid directly, as soon as the sample of water was brought on board, by boiling it down nearly to dryness, and drawing a current of air through it, which conveyed the steam and carbonic acid into a suitable receiver charged with baryta water. In the *Challenger* substantially the same method was employed, with this important addition, that an excess of a saturated solution of chloride of barium was added to the water before distilling. By precipitating the sulphates, their effect in reducing the tension of the carbonic acid was destroyed, and also the liquid was got into a condition in which it boiled calmly, without bumping, until almost quite dry. The object aimed at was the determination of the carbonic acid present in the water in the free or *half-bound* state, to the exclusion of that present as neutral carbonate. There is no doubt that this was successfully accomplished, and the experiments made by Dr. Tornoe furnish satisfactory evidence. "In order to ascertain whether the decomposition by boiling of the neutral carbonates in sea-water also took place to a considerable extent when insoluble sulphates were present in that fluid, I made a few experiments by Buchanan's process. From several samples of sea-water, which, examined by the method I adopted, were found to contain 96 mgr. of carbonic acid per litre, I succeeded, by evaporation to dryness, after adding a solution of chloride of barium, in liberating about 50 mgr. only, with a solitary exception, when the amount exceeded 50 mgr. per litre. The proportion of carbonic acid expelled was accordingly not much greater than that determined by Buchanan in water from equatorial seas, and but a few milligrammes in excess of what the carbonic acid forming bicarbonates, according to trustworthy observations, should have been; of the carbonates said to be present in the residue I failed to detect any trace." This experiment shows that what was sought was really obtained, namely, the determination of the carbonic acid *not* present as neutral carbonate.

The method finally adopted by Dr. Tornoe is an exceedingly ingenious one, and has the great advantage of giving both the free and the bound carbonic acid. It consists in adding to the sample of water a measured quantity of acid of known strength, driving off the liberated carbonic acid by gentle heating, and collecting it in baryta water of known strength. When the operation is finished, the excess of acid in the boiling flask and the excess of alkali in the receiver are separately determined. The amount of baryta neutralised gives the total carbonic acid, while the amount of acid neutralised gives the amount present as neutral carbonate.

It does not seem to have occurred to Dr. Tornoe that his method of determining the carbonic acid might be combined with the boiling out of the oxygen and nitrogen. If to the sample from which the gases are to be extracted by boiling under reduced pressure be added sufficient acid to more than neutralise the carbonates, and the boiling be then continued as if for the elimination of the oxygen and nitrogen, the whole of the carbonic acid should be obtained along with these gases, while the excess of acid in the flask could be measured when the operation was finished. This process would have the advantage that oxygen, nitrogen, and carbonic acid would be collected in one operation. It would be necessary to make the tube in which the gases are to be preserved larger than is at present usual, but a volume of 100 cubic centimetres would suffice for a volume of 800 or 900 cubic centimetres water.

By this method the carbonic acid was determined in seventy-eight samples of water from different parts. It is somewhat of a pity that the determinations were not made on board when the samples were fresh, though there is no doubt that in the case of sea waters which contain only traces of organic matter, the amount of carbonic acid is not sensibly affected by keeping. The results obtained are very uniform, and he gives the following average formulæ:—

$$52 \cdot 78 \pm 0 \cdot 83 \text{ mgr. per litre}$$

for the carbonic acid forming carbonates with a probable error in a single observation of $\pm 0 \cdot 662$ per litre; and

$$43 \cdot 64 \pm 0 \cdot 16 \text{ mgr. per litre}$$

for the carbonic acid, forming bicarbonates with a probable error in a single observation of $\pm 1 \cdot 26$ mgr. per litre."

Touching the uniformity of these results, it must be observed that the samples would probably be all at nearly the same temperature when examined, while they would be collected at different and lower temperatures. Hence the fact of keeping would tend to produce uniformity in the results. Hence also there is no mention of temperature in his average formulæ. Now although the law regulating the absorption of carbonic acid by sea water at

different temperatures cannot be precisely stated, the *Challenger* results leave no doubt that more carbonic acid is absorbed the lower the temperature is. Taking the mean of all the *Challenger* determinations in surface water at temperatures between 10° C. and 15° C., we have 43·5 mgr. per litre of carbonic acid liberated by boiling to nearly dryness after precipitation of the sulphates; and this agrees to a fraction of a milligram with Tornoe's average amount of carbonic acid present as bicarbonate.

Dr. Tornoe concludes this part of the work with an interesting inquiry into the condition in which the carbonic acid exists in the water, and comes to the conclusion that it is probably present in combination with soda, forming bicarbonate of soda.

In the third portion of his work Dr. Tornoe gives an account of his experiments on the amount of salt held in solution by the sea water. For determining it he follows two methods, the one depending on the specific gravity, and the other on the chlorine contained in the water. The specific gravity was determined by means of suitable glass hydrometers, and the chlorine by means of silver solution of known strength. In order to reduce the specific gravities which were observed at various temperatures to their value at one standard temperature, Dr. Tornoe reports an elaborate series of experiments on the expansion of sea water due to change of temperature, and he uses the results so obtained along with those of Ekman for reducing his results. They are given in two columns; in the one is the specific gravity at 17·5° C. referred to that of distilled water at the same temperature as unity; in the other they are reduced to their value at the temperature of the water when *in situ*, referred to distilled water at 4° C. as unity.

In order from these results to arrive at a knowledge of the amount of solid matter dissolved, he makes a series of careful determinations of solid residue of chlorine and of specific gravity in seven samples of water. He finds that "the co-efficient of chlorine may be taken at—

$$1·809 \pm 0·00076$$

with a probable error in a single determination of ± 0·002, and the co-efficient of specific gravity at—

$$131·9 \pm 0·058$$

with a probable error in a single determination of ±0·15." The specific gravity is here taken at 17·5° C., and the unit is that of distilled water at the same temperature.

The determination of the solid residue in sea-water presents special difficulties due to the presence of so large amounts of magnesia salt. These difficulties are overcome in an ingenious way:—"From 30 gr. to 40 gr. of sea-water were introduced into a thick porcelain crucible of known weight furnished with a tight-fitting cover, and evaporated on a water-bath. So soon as the salt was sufficiently dry the crucible with the cover on was heated for about five minutes over one of Bunsen's gas-burners, then cooled and weighed with its contents."

The free magnesia liberated by this process was then determined by dissolving the salt and adding a quantity of titrated sulphuric acid and determining what remained unneutralised by titrating with caustic soda.

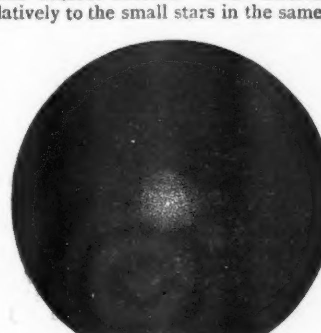
The results so obtained are given in a table, and also represented graphically in charts at the end of the work. These charts show very clearly the distribution of the water from the Atlantic amongst that coming from Polar regions, which is also confirmed not only by the temperatures observed, but also by the distribution of nitrogen dissolved in the bottom water, of which Dr. Tornoe has given a chart. It is well known that the water coming up from the North Atlantic is much salter than that coming south from the Arctic and Polar regions. From the variations in the amount of salt found in the bottom water of different districts Dr. Tornoe suspected that some of it must be due to the presence of Atlantic water which had got cooled on its way north, and had sunk to the bottom. It is in the highest degree probable that the nitrogen found dissolved in a sea-water, taken from any depth, is the nitrogen which it took up when last exposed to the atmosphere. Now the amount of nitrogen which it would take up would depend to a great extent on the temperature, so that water which had been exposed at the surface in Arctic regions would take up more nitrogen than water which had been exposed in temperate regions, so that the amount of nitrogen present, for instance, in a bottom water, may be taken to indicate the temperature which the water had when last exposed to the atmosphere. Now it is a remarkable result of Dr. Tornoe's investigations that where he finds a high percentage of salt in the bottom water he also finds a low percentage of nitrogen, and *vice versâ*, rendering it in every way probable that the areas which he has mapped out are really supplied on the one hand from the Atlantic, and on the other from the Arctic Oceans. This result is a further evidence of the importance of accurate determinations of the gaseous contents of sea-water.

It is impossible to conclude this notice without congratulating the Norwegian nation on the advanced position which it has taken up in ocean exploration and the success which has attended the labours of its servants, and in an especial way of Prof. Mohn and those associated with him in the three summer trips of 1876, 1877, and 1878. Not only is the work done great in amount and of the highest scientific interest, but it has been published with a praiseworthy expedition which adds immensely to its present value.

J. Y. BUCHANAN

COMET *f* 1881

ON the morning of October 4, 1881, while engaged in sweeping the eastern sky for new comets, I found an object about 10 degrees preceding α Leonis on the ecliptic which bore a strong resemblance to a bright round nebula, with a marked condensation in the centre. I roughly estimated the position of the object, and referring to Herschel's catalogue of nebulæ, endeavoured to identify it, but without success. Then carefully noting its place relatively to the small stars in the same field of my



Comet *f* 1881, October 3, 15h. 15m.; 10-inch reflector, power 25.

10-inch reflector, I resumed sweeping in the region near. About half an hour later—3 45 a.m.—I re-observed the object, as clouds were rapidly coming up. A slight motion to the eastward was at once suspected to have occurred in the interval, but my positions were merely eye estimations, and I distrusted them though feeling certain at the time that the supposed displacement was real. I had only obtained a momentary glimpse when the sky became completely overcast, but fortunately the ensuing night was cloudless, and I was enabled to obtain another observation. The suspected object did not rise until soon after 1 a.m., and I knew that it would not come under the

range of my 10-inch reflector before about 2h. 30m. a.m. Apart from this, the moonlight was very troublesome. Adjusting the telescope I immediately saw the small stars of the preceding night, but the nebulous object had disappeared though it was found directly afterwards in a place about half a degree east of its position on the previous morning. The true character of the object thus became unmistakeable. It was a telescopic comet with an apparent motion towards the sun, though really the distance between the two bodies was daily becoming greater, owing to the fact that the sun's apparent motion eastwards along the ecliptic was about twice as great as that of the comet.

Information of the discovery was telegraphed to Greenwich and Dun Echt, and subsequently the Astronomer-Royal sent notification to some of the chief foreign observatories. Coggia at Marseilles, the discoverer of the great comet of 1874, picked up the new comet on the night (October 5) following the receipt of the telegram, and on October 9 it was observed by Messrs. Lohse and Copeland at Dun Echt. But at Harvard College Observatory (U.S.) it was looked for in vain, for the comet managed to elude detection until a special message had been dispatched from Lord Crawford's observatory, giving its accurate place, when it was ultimately found by Mr. Wendell. It was observed at the latter station on the nights of October 10 and 11, and the positions obtained then, in combination with a Dun Echt place of October 9, enabled Mr. Chandler to compute approximate elements, from which it appeared that the comet was receding both from the earth and the sun, and the orbit presented some resemblance to that of the comets of 1819 IV. and 1771 I. Parabolic elements were subsequently computed by Messrs. Copeland and Lohse, by Dr. Oppenheim at Vienna, J. Palisa at Wien, and by Mr. J. R. Hind at London. It soon became evident however that an elliptical orbit would best satisfy the later observations, and M. L. Schulhof at Paris was the first to compute them, using the Marseilles position of October 5, Dun Echt October 9, and Paris October 18. He gave the period as 7¾ years, though admitted that a considerable amount of uncertainty was attached to this result. Elliptic elements were also computed by Prof. Winnecke at Strassburg, by Mr. S. C. Chandler at Boston (U.S.), and by Herr Block at Odessa, the resulting periods being 8·407 years, 8·343 years, and 9·106 years respectively. Schulhof also reconstructed the orbit on the basis of many later positions, and deduced the period as 8·45 years, which is in very close agreement with the results of Prof. Winnecke and Mr. Chandler. The following are the elements as computed by Messrs. Schulhof and Winnecke respectively:—

Perihelion Passage, Sept. 13·25866 Berlin mean time.

		°	′	″
Longitude of perihelion	=	312	21	0·4
Longitude of node	=	65	57	50·0
Inclination	=	6	51	36·2
ϕ	=	55	37	25·8
log. q	=	9·860192		
log. e	=	9·916637		
log. a	=	0·618020		
Period	=	8·45 years.		

Perihelion Passage, Sept. 13·1697 Berlin mean time.

		°	′	″
Longitude of perihelion	=	312	11	22
Longitude of node	=	66	4	2
Inclination	=	6	52	36
ϕ	=	55	34	7
log. q	=	9·859955		
log. a	=	0·616427		
Period	=	8·4072 years.		

Herr Block finds the period 9·106 years, and remarks (*Science Observer* Circular, No. 21) that "the orbit of the comet is similar to the orbits of comets 1743 I. and 1819 IV., which Prof. Clausen supposed to be identical (*Ast. Nach.* x. p. 363), but, in this case, the time of revolution should be nearly 7·7 years. The orbit is also similar to the orbit of the comet of 1585, excepting that the perihelion distance is very different. Supposing that there were 17 revolutions between 1585 and 1743, and 15 revolutions between 1743 and 1881, the time of revolution would be 9·252 and 9·253 years. The comet of 539 also accords with the period of 9·25 years."

M. Schulhof says that the period may possibly be larger than that assigned in his elements, as there are deviations in the middle places of the orbit seeming to suggest such a conclusion. It is explained in *Science Observer*, No. 35, p. 94, that this comet approaches nearer to the earth than any other, except that of Biela, of whose continued existence we are becoming very sceptical. It is singular that the new comet evaded discovery so long, for it must have been a conspicuous object in the southern hemisphere in August, for on the 18th of that month it was "within 11,000,000 miles of the earth, and its brilliancy equal to forty or fifty times that at discovery, and in fact easily visible to the naked eye."

The last observation of this new periodical comet was made, I believe, by Prof. Winnecke on November 19 with the 20-inch refractor at Strassburg Observatory, when the position was α = 10h. 40m. 32·92s., $\delta = 14° 49' 30''·7$ N. at 16h. 46m. 38s. Strassburg mean time.

As this comet approaches somewhat near to the earth, the idea occurred to me that it might very possibly be associated with one of the numerous meteor streams which I had observed during the few preceding years, but the theoretical radiant point of the comet is a southerly one, and is so near the sun that the chances of its observation are very meagre. Prof. Herschel computes that the earth passes the comet's ascending node on November 28, when the radiant point of any meteors following the orbit of the comet would be at R.A. 272°, Dec. 37° S., which is near ϵ Sagittarii, and 29° south—following the sun's place. The meteor speed would be = 14 miles per second, but the shower could only be observed in the early evening, inasmuch as the radiant sets about half an hour after the sun. On December 14 the cometary orbit passes + ·033 N. of the earth's orbit, and the radiant point is at α 277°, δ 34° S., but in this case also a shower of meteors proceeding from the comet would be invisible, because the radiant sets with the sun.

A good deal has been said with reference to the supposed resemblance of orbit between this comet and Blanpain's (1819 IV.), but if they are identical the orbit and period have undergone remarkable changes since 1819, and the question cannot be definitely settled until the perturbations arising from the action of Jupiter have been investigated. It must be admitted that some comets, as for example Lexell's, have been drawn into new orbits by planetary influence, and it is possible that the cumulative effects of this may have brought about a lengthening of the period in the present case, for the period of Blanpain's comet, as computed by Encke, was only 4·81 years, which is not considerably more than one-half that of the new periodical comet. Whether the latter will return at its predicted epoch in 1890 is open to some conjecture, but a careful investigation of the orbit and of the perturbations which must affect it in the interval, will to a great extent remove the difficulties. The comet is evidently a bright one, and in certain positions will be presented as a conspicuous object, so that it may have been frequently observed during former returns to perihelion, though the great variations in its orbit originated by perturbation, make it difficult to reconcile the orbital elements at different returns. The comet may also have often escaped discovery at its re-appearances similarly to the perodical comets of Encke and others, which must manifestly increase the difficulty of fixing with any degree of certainty the epochs of its former apparitions. It is, however, satisfactory that the comet at its recent return was fairly well

observed, and its elliptical elements having been computed on several hands with marked consistency, we may assume that its present form of orbit is known with considerable accuracy.

W. F. DENNING

THE MAKING OF ENGLAND[1]

IN an instructive article in *Macmillan's Magazine* for this month, Prof. Geikie shows what important influences the geological development of our country has had upon its history. Prof. Geikie begins in long past prehistoric times, when England formed part of the European continent, and rapidly traces the changes which have gone to make England what it is; shows the bearing which the physical geography of the country had on the settlements of the early inhabitants, pre-Aryan and Aryan, and in later times on the development of England's commerce, and the growth of her greatness. What Prof. Geikie does for England as a whole Mr. Green attempts to do for "Anglo-Saxon" England, for that England which was destined to form the broad basis of the England of the present day. Mr. Green, in his well-known "History of England," as we pointed out at the time of its publication, made some attempt to take account of the physical conditions of our country in so far as they have influenced her history; and this is essentially the method he followed in his valuable text-book of British Geography. Hitherto historians have taken little or no account of the environment of nations, although it is evident that that must be a factor of the first importance in determining the character of a people and their historical development. In a general way every one must admit that the climate and physical condition of a country have their influence on the character of a people; but in its strictly scientific aspect the subject is yet in its infancy, and we hope that Mr. Green's example will encourage others, both historians and scientific geographers, to work it out thoughtfully and minutely. It is not our province to examine Mr. Green's work critically, as an historical treatise; we shall leave it to others to say whether all his statements and inferences are authorised by the documents on which they are based. But that the work is full both of interest and instruction every one must admit. Mr. Green's geographical and topographical instincts are unusually keen, and his faculty for clothing the dry bones of chronicles, and antiquarian discoveries, and ethnological data with living flesh and blood is probably unsurpassed. In a series of pictures he brings before us our Teutonic forefathers with a vivid force that has all the interest and excitement of reality. We see them hovering off the shores of England, even while the Romans were in possession, watching their opportunity to pounce down upon the prosperous towns and homesteads; we see them at last get a firm footing, south and east and north, holding the coast regions with comparative ease, but baffled for years by the primeval forests and thick underwood, the widespread marshes and impassable rivers. Not for at least two centuries were they able quite to overcome these obstacles, and these, with the other physical features of the country, determine the relative positions ultimately occupied by Jute, Angle, Saxon, and Celt. With regard to the last-mentioned, Mr. Green, from a study of the finds in the Settle and other caves, is able to bring before us a touching picture of the flight of the Celtic men, women, and children with what utensils and ornaments they could carry with them before the advance of the ruthless Saxon.

"The hurry of their flight may be gathered from the relics their cave-life has left behind it. There was clearly little time to do more than to drive off the cattle, the swine, the goats, whose bones lie scattered round the hearth fire at the mouth of the cave, where they served the wretched fugitives for food. The women must have buckled hastily their brooches of bronze or parti-coloured enamel, the peculiar workmanship of Celtic Britain, and snatched up a few household implements as they hurried away. The men, no doubt, girded on as hastily the swords whose dainty sword-hilts of ivory and bronze still remain to tell the tale of their doom, and hiding in their breast what money the house contained, from coins of Trajan to the wretched 'minims' that told of the Empire's decay, mounted their horses to protect their flight. At nightfall all were crouching beneath the dripping roof of the cave or round the fire that was blazing at its mouth, and a long suffering began in which the fugitives lost year by year the memory of the civilisation from which they came. A few charred bones show how hunger drove them to slay their horses for food; reddened pebbles mark the hour when the new vessels they wrought were too weak to stand the fire, and their meal was cooked by dropping heated stones into the pot. A time seems to have come when their very spindles were exhausted, and the women who wove in that dark retreat made spindle whorls as they could from the bones that lay about them."

Then, when the invader has settled down in his conquests, the author restores to us with the broadness of reality, partly with material obtained by the researches of the archæologist, their mode of life, the nature and disposition of their *tuns* or settlements, the life of earl, ceorl, labourer, and slave, and to show us in the town *moot* the germs of our modern complicated parliament.

Mr. Green has evidently taken the greatest pains to master the physical geography and the great topographical features of the country at the landing of the Teutonic invaders. It was in many respects as different as possible from the surface with which we are at present familiar. The New Forest, Cranbourne Chase, and other scanty forests are but the remains of what at that period was almost one universal forest, impenetrable to all but natives, thickly clothed with underwood, and from which the great chalk-ranges rose, and provided almost the only settling-places of the inhabitants. Nowadays we find all our great cities along the river valleys or the coast; then the uplands were the only areas on which the inhabitants could settle, the marshy and wood-grown banks of the rivers being all but uninhabitable.

"It was not merely its distance from the seat of rule or the later date of its conquest that hindered the province from passing completely into the general body of the Empire. Its physical and its social circumstances offered yet greater obstacles to any effectual civilisation. Marvellous as was the rapid transformation of Britain in the hands of its conquerors, and greatly as its outer aspect came to differ from that of the island in which Claudius landed, it was far from being in this respect the land of later days. In spite of its roads, its towns, and its mining-works, it remained, even at the close of the Roman rule, an 'isle of blowing woodland,' a wild and half-reclaimed country, the bulk of whose surface was occupied by forest and waste. The rich and lower soil of the river valleys, indeed, which is now the favourite home of agriculture, had in the earliest times been densely covered with primæval scrub; and the only open spaces were those whose nature fitted them less for the growth of trees, the chalk downs and oolitic uplands that stretched in long lines across the face of Britain from the Channel to the Northern sea. In the earliest traces of our history these districts became the seats of a population and a tillage which have long fled from them as the gradual clearing away of the woodland drew men to the richer soil. Such a transfer of population seems faintly to have begun even before the coming of the Romans; and the roads which they drove through the heart of the country, the waste caused by their mines, the ever-widening circle of cultivation round their towns, must have quickened this social

[1] "The Making of England." By John Richard Green, M.A., LL.D Maps. (London: Macmillan and Co., 1881.)

change. But even after four hundred years of their occupation the change was far from having been completely brought about. It is mainly in the natural clearings of the uplands that the population concentrated itself at the close of the Roman rule, and it is over these districts that the ruins of the villas or country houses of the Roman landowners are most thickly scattered."

As an instance of how Mr. Green is able to throw light upon the progress of the Saxon conquest by his mastery of the physical condition of the country at the time, we quote another passage referring to the settlement of the Jutes. After describing the advance into the Caint (Kent) of the band under Hengest, Mr. Green goes on:—

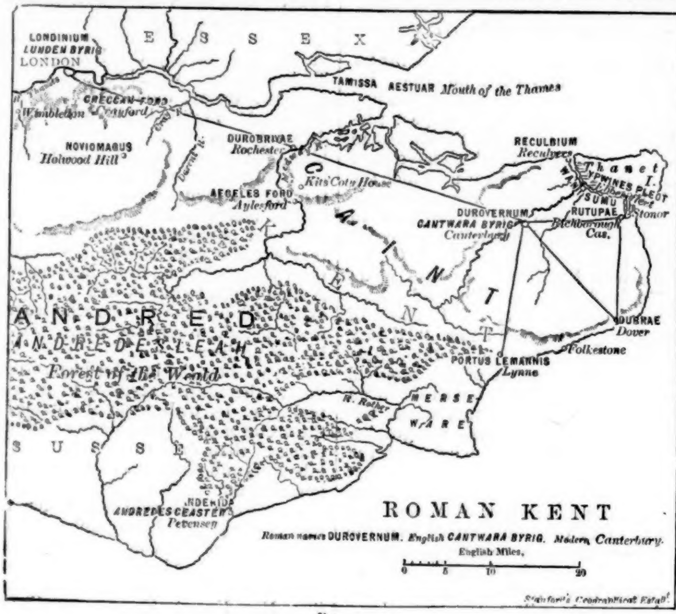


FIG. 1.

"With this advance to the mouth of the Weald the

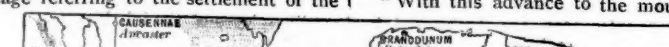


FIG. 2.

work of Hengest's men came to an end; nor did the Jutes from this time play any important part in the attack on the island, for their after-gains were limited to the Isle of Wight and a few districts on the Southampton Water. Fully indeed as the Caint was won, no district was less fitted to serve as a starting-point in any attack on Britain

it large. While the Andredsweald, which lay in an impenetrable mass along its western border, extended southward behind the swamps of Romney Marsh to the coast of the Channel, a morass that stretched from the hills of Dulwich to the banks of the Thames blocked the narrow strip of open country between the northern edge of the Weald and the river. The more tempting waterway along the Thames itself was barred by the walls, if not by the fortified bridge, of London. The strength of these barriers is proved by the long pause which took place in the advance of the Jutes, for a century was to pass before they made any effort to penetrate further into the island" (Fig. 1).

Again the advance of the East Saxons was hindered by obstacles quite as formidable as the Andredsweald in South Britain. "As the South Saxons were prisoned within their narrow strip of coast by the reaches of the Andredsweald, so the East Saxons found themselves as effectually barred from any advance into the island by a chain of dense woodlands, the Waltham Chace of later ages, whose scanty relics have left hardly more then the names of Epping and Hainault Forests. These woodlands, which stretched at this time in a dense belt on either side the Roding along the western border of the district that the invaders had won from the Thames to the open downs above Saffron Walden, and were backed to the west by the marshy valley of the Lea, whose waters widened into an estuary as it reached the Thames, seem to have been wholly uninhabited, for no trace remains in their area of military stations or of the country houses or burial-places of the provincials. How impassable in fact these fastnesses had been found by the Romans is clear from the fact that even their road-makers never attempted to penetrate them. The lower portion of the Ermine Street, the road to the north, which in later days struck direct through this district from London to Huntingdon, did not exist in Roman times, and the British provincial was forced to make a circuit either by Leicester or Colchester on his way to Lincoln and York."

Further north again the progress of the Angles

EARLY LONDON.

(Local names around of later date.)

Fig. 3.

in what was known afterwards as East Anglia, and further north still in modern Lincolnshire, was naturally influenced by the widespread marsh, the remains of which are still to be seen in the Fen country. "We have seen what barriers held back the Jute of Kent and the Saxon on either side of him; but barriers as impassable held back the Engle of the eastern Gwent, for the forest-line which began on the Thames reached on along their western frontier to the Wash, and the Wash stretched to the northward from Newmarket to the sea. The fens which occupied this huge break in the eastern coast of Britain covered in the sixth century a far larger space than now; for while they stretched northward up the Witham almost as far as Lincoln, and southwards up the Cam as far as Cambridge, they reached inland to Huntingdon and Stamford, and the road between those places skirted their bounds to the west. So vast a reach of tangled marsh offered few temptations to an invader; and we shall see grounds at a later time for believing that the Gyrwas, as the Engle freebooters who found a home in its islands called themselves, were for a long time too weak to break through the line of towns that guarded its inner border" (Fig. 2).

One of the most interesting passages, with its accompanying map, in Mr. Green's book, is that in which he describes the probable founding of London, the nature of the ground in which it stood, and the surrounding wild country, all now covered and its features obliterated by many square miles of bricks and mortar. Mr. Green shows how it was that what was destined to be the greatest city in the world came to be planted where it is, and how its future progress was determined by the physical conditions of its site.

"The commercial greatness of London has made men forget its military importance, but from the first moment of its history till late into the middle ages London was one of the strongest of our fortresses. Its site, indeed, must have been dictated, like that of most early cities, by the advantages which it presented as well for defence as for trade. It stood at the one point by which either

merchant or invader could penetrate from the estuary into the valley of the Thames; and in its earlier days, before the great changes wrought by the embankment of the Romans, this was also the first point at which any rising ground for the site of such a town presented itself on either shore of the river. Nowhere has the hand of man moulded ground into shapes more strangely contrasted with its natural form than on the site of London. Even as late as the time of Cæsar the soil which a large part of it covers can have been little but a vast morass. Below Fulham the river stretched at high tide over the ground that lies on either side of its present channel from the rises of Kensington and Hyde Park to the opposite shores of Peckham and Camberwell. All Pimlico and Westminster to the north, to the south all Battersea and Lambeth, all Newington and Kennington, all Bermondsey and Rotherithe, formed a vast lagoon, broken only by little rises which became the "eyes" and "hithes," the "islands" and "landing-rises," of later settlements. Yet lower down to the eastward the swamp widened as the Lea poured its waters into the Thames in an estuary of its own, an estuary which ran far to the north over as wide an expanse of marsh and fen, while at its mouth it stretched its tidal waters over the mud flats which have been turned by embankment into the Isle of Dogs. Near the point where the two rivers meet, a traveller who was mounting the Thames from the sea saw the first dry land to which his bark could steer. The spot was in fact the extremity of a low line of rising ground which was thrown out from the heights of Hampstead that border the river valley to the north, and which passed over the sites of our Hyde Park and Holborn to thrust itself on the east into the great morass. This eastern portion of it, however, was severed from the rest of the rise by the deep gorge of a stream that fell from the northern hills, the stream of the Fleet, whose waters, long since lost in London sewers, ran in earlier days between steep banks—banks that still leave their impress in the local levels, and in local names like Snow Hill—to the Thames at Blackfriars. The rise or 'dun' that stretched from this tidal channel of the Fleet to the spot now marked by the Tower, and which was destined to become the site of London, rose at its highest some fifty feet above the level of the tide, and was broken into two parts by a ravine through which ran the stream which has since been known as the Wallbrook. Such a position was admirably adapted for defence; it was indeed almost impregnable. Sheltered to east and south by the Lagoons of the Lea and the Thames, guarded to westward by the deep cleft of the Fleet, it saw stretching along its northern border the broad fen whose name has survived in our modern Moorgate. Nor, as the first point at which merchants could land from the great river, was the spot less adapted for trade. But it was long before the trader found dwelling on its soil. Old as it is, London is far from being one of the oldest of British cities; till the coming of the Romans, indeed, the loneliness of its site seems to have been unbroken by any settlement whatever. The 'dun' was in fact the centre of a vast wilderness. Beyond the marshes to the east lay the forest track of southern Essex. Across the lagoon to the south rose the woodlands of Sydenham and Forest Hill, themselves but advance guards of the fastnesses of the Weald. To the north the heights of Highgate and Hampstead were crowned with forest-masses, through which the boar and the wild ox wandered without fear of man down to the days of the Plantagenets. Even the open country to the west was but a waste. It seems to have formed the border-land between two British tribes who dwelt in Hertford and in Essex, and its barren clays were given over to solitude by the usages of primæval war."

Much more that must be of interest to those familiar with modern London does Mr. Green tell us about the early city and its progress, and the influence upon its history, of its site, and the nature of the surrounding country. But these extracts will give the reader a fair idea of the method pursued by Mr. Green in this most interesting volume. The work contains numerous maps showing the condition of the surface in the various regions of the country at the time that the Saxons, Jutes, and Angles were with ruthless vigour laying the foundation of modern England and modern English history. Mr. Green, of course, discusses many incidental questions of interest, among others the extent to which the Celtic element remained after the settlement of the invaders, and influenced their blood and their character. Mr. Green essentially adopts the views advocated by Mr. Freeman, though his Teutonism does not appear to us to be quite so extreme. He brings his history down to about the year 830, when it may be said that England was roughly shaped into those outlines, topographical and social, of which the present conditions are the lineal development.

NOTES

AT a recent meeting of the Trustees of the Lewes Studentship in Physiology, which was founded by the late "George Eliot" in memory of her husband, Mr. George Henry Lewes, the vacancy occasioned by the appointment of Dr. Roy to the Brown Professorship of Pathology in the University of London was filled up, according to the terms of the Trust, by the election of Mr. L. C. Wooldridge, D.Sc. (Lond.). Dr. Wooldridge is a former student of Guy's Hospital, who has lately been working in Prof. Ludwig's laboratory at Leipzig. He has already made investigations of importance, one of which, on the part taken by the white corpuscles in the coagulation of the blood, has been read before the Royal Society. The studentship is for three years, and its conditions provide for the holder devoting himself during that time to physiological researches. Wisely administered, such endowments of research are invaluable, and it is to be wished that there were more of them. The first appointment of the Trustees led to the brilliant work of Prof. Roy, and we do not doubt that their present choice will be no less amply justified.

THE expedition to be fitted out at the expense of M. Bischoffsheim to observe the solar eclipse next May in Egypt, will include M. Perrotin, director of the Nice Observatory, who will attend specially to the search for intra-Mercurial planets, and M. Thollon, who will have charge of the spectroscopic work. They will be accompanied by M. Guérain, photographer to the Paris Observatory.

THE collection of fossil fishes in the British Museum has lately received an immense addition by the transference from Florence Court to the new museum at Cromwell Road of the very extensive and important collection of the Earl of Enniskillen, and when in the course of a few weeks it receives the collection of the late Sir P. G. Egerton, which the Trustees have also purchased, the museum will contain a probably unrivalled collection of fossil fish. The collections of the late Sir P. G. Egerton and of the Earl of Enniskillen were commenced in 1826, when they were fellow-students at Oxford.

THE first annual general meeting of the Sanitary Protection Association was held on Saturday in the rooms of the Society of Arts in the Adelphi. Prof. Huxley, having read the report, pointed out that the Society, though it had only been in existence for a short time, had worked successfully. The houses examined had not been the dwellings of poor people, and therefore liable to be found in an insanitary condition, but had been houses occupied by well-to-do people, and of these 6 per cent. were in an absolutely pestiferous condition, leaving it to be the merest chance that they

had not become hotbeds of disease. In addition to this, in two-thirds of the houses inspected there were defects in the drainage arrangements, such as must fill any careful person with alarm, especially where children or delicate persons were among the occupants. Prof. Fleeming Jenkin, one of the consulting engineers of the Association, spoke of the careful manner in which the business arrangements of the Association were conducted, and expressed an opinion that the continued existence of such associations as this must necessarily result in a much more efficient official inspection of dwelling-houses in all parts of the country. Speaking from personal experience of Edinburgh, in which only a similar association exists, Prof. Jenkin said during the recent run of an epidemic of typhoid there had only been one case in any of the houses under the charge of the Association, and in that case the fever was shown to have been contracted by the lady of the house while visiting the sick poor in the vilest districts of the city.

THE discovery of cæsium and rubidium by Bunsen and Kirchhoff was, it is known, one of the first fruits of spectrum analysis. These are the most electro-positive of all known elements, and have a remarkable affinity for oxygen—so great in the case of cæsium, that it has heretofore been found impossible to isolate the metal. The problem, however, has now been solved by Herr Setterberg (*Ann. der Chemie*, Bd. 211, p. 100), by electrolysis of a fused mixture of cyanide of cæsium and cyanide of barium (large quantities of these costly substances having been placed at his disposal). Cæsium is quite like the other alkali metals; it is silver white, and very soft and extensible. Its melting-point is about 26°·5 C.; and its specific gravity 1·88. In the air it ignites spontaneously, and when thrown on water behaves quite like sodium, potassium, and rubidium. Herr Setterberg has anew proved in his experiments that it is quite impossible to obtain cæsium by the method adopted for rubidium and potassium, distilling the carbonate with charcoal at a white heat.

AMONG the institutions for which Jamaica is indebted to the energy and intelligence of the present Governor, Sir Anthony Musgrave, the Institute of Jamaica is probably destined to prove one of the most valuable as a means of diffusing information and organising local effort in the cause of industrial science. The Institute was constituted by a recent law which created a Board styled "The Board of Governors of the Institute of Jamaica," consisting of seven members appointed by the Governor; their duties being to establish and maintain an institution comprising a library, reading-room, and museum; to provide for the reading of papers, delivery of lectures, &c., and holding of examinations on subjects connected with literature, science, and art; to award premiums for the application of scientific and artistic methods to local industries; and to provide for the holding of exhibitions illustrative of the industries of Jamaica. The Institute occupies a building known as Date Tree Hall, in Kingston. On the lower floor there is a small museum containing a good geological collection made by the members of the late Geological Survey, a very complete conchological collection, and another of the birds of Jamaica. A beginning has also been made to form a collection of the fish of Jamaica, and about 150 duplicate specimens have been sent to the Smithsonian Institution to be named by Prof. Baird. On the upper floor is a library which contains a valuable collection of old local prints and records, as well as some 2000 volumes of standard European and American literary and scientific works. The Jamaica Institute in its present form is intended to occupy the position and take up the work of the late Royal Society of Arts and Agriculture, and it receives an annual vote from the Local Government. The present chairman of the Institute is the Hon. Ed. Newton, Lieut.-Governor and Colonial Secretary. Although under its new organisation it has only been in existence about three years, it appears to have already made a good start. Branch associations have been established at Spanish Town, Falmouth, and Sav-la-Mar. Prizes have been offered and awarded for several local industries, and an annual Flower and Horticultural Show has been started with the view of encouraging the cultivation of flowers, fruits, and vegetables. The Governors have recently published in a combined form six lectures delivered under their auspices last year in the Town Hall, Kingston, on local industries. They consist of "Objects of the Jamaica Institute," by the chairman, the Rev. John Radcliff; "Root-Food Growth in Jamaica," by the Rev. Josias Cork, Rector of St. Anne's; "Some Objects of Productive Industry," Part I. Coffee; Part II. Cinchona, by D. Morris, M.A., F.G.S., Director of Public Gardens and Plantations; "The Timbers of Jamaica," by W. Bancroft Espent, F.L.S.; "Stock and Stock-raising," by Archibald Roxburgh; and "The Mineral Springs of Jamaica," by Dr. J. Cecil Phillips. These lectures are of an essentially practical character, and their publication in a handy and compact form must tend to develop the numerous resources of the island.

WE have received a prospectus of the *Journal of the Royal Agricultural and Commercial Society of British Guiana*, edited by Mr. Everard F. im Thurn, M.A., Oxford, and Curator of the British Guiana Museum. This journal, which is to be published half-yearly, on the 30th of June and the 31st of December, is intended to contain not only or chiefly a record of the procedings of the Society of which it is to be the organ, but also papers and occasional notes on agricultural, commercial, geographical, meteorological, chemical, botanical ornithological, entomological, anthropological, and literary subjects connected with British Guiana. A meteorological record will, as soon as it can be organised, form a regular feature in the journal. Lists of the known flora and fauna of the country will be given from time to time, as they can be prepared. A series of vocabularies of the Indian languages of Guiana is also in preparation. Folk-lore, collected from the Negroes and Indians, will occasionally be given, and many other kindred subjects will be treated. The importance of such a journal must be evident, and we hope Mr. im Thurn will receive adequate encouragement.

UNDER the title of "The Natural History of Leeds, Wharfedale, and Nidderdale," it is the intention of the Council of the Leeds Naturalists' Club and Scientific Association to publish during the forthcoming summer a summary of what is at present known of the animals inhabiting the districts marked out for special investigation by the Club. The Club has now been in existence for twelve years, during which time its members have—with more or less assiduity—collected and studied the local fauna, the result being the accumulation of a considerable mass of information, and the time has now arrived at which—if further progress is to be achieved—an epitome of what is already known should be published. The chief hindrance to progress now felt is the acknowledged want of an account of the work already accomplished, as a starting point for fresh investigations and new discoveries. Not only will the work comprise lists of the more important and well-investigated groups of animals, but it will include a notice of every group, however meagrely or imperfectly some of the more obscure ones may have been studied.

AT Angleur, close to Liége, an important archæological discovery has been made. At a depth of only 50 to 60 centimetres about twenty antique bronzes, some of remarkably fine workmanship, have been found. Amongst them are two female statuettes, one statuette of a youth, two female heads, three bearded Mercury heads, two tiger's heads, a lion with raised claw, &c. All

the objects are covered with fine green Patina, and are evidently the parts of an ancient fountain, which adorned the hall or garden of the villa of a wealthy Roman. The discovery is all the more interesting, as the existence of Roman antiquities in the neighbourhood of Liége has never been suspected before.

THE sudden and highly unpleasant occurrence of large quantities of sulphuretted hydrogen at Aetolikon (near Missolunghi), to which we referred a short time ago, was repeated on January 6 last. At the same time a slight earthquake was observed, and quantities of pumice-stone were observed floating upon the sea surface. Orders were given by the authorities to investigate the phenomenon scientifically with a view to ascertaining whether a rise of temperature has taken place in the sea-water or soil of the shore. The depth of the sea is also to be measured, to see whether any variations have taken place.

THE Göttingen Royal Society of Sciences offers, in the physical class, a prize of 50 ducats (say 23*l.*) for the best investigation, with accurate experiments, of the chlorides and amides of cyanogen (the present data regarding these compounds being rather uncertain). Papers must be sent in before the end of September, 1884. The same month this year closes the time for treatment of the prize question in the mathematical class, viz. the nature of the unpolarised ray of light.

THE seeds of some valuable new species or varieties of *Cinchona* that have not, it seems, as yet been introduced to the Indian plantations have recently been consigned to Messrs. Christy and Co., of Fenchurch Street. These new forms are very rich in quinine, and are thus referred to in Markham's "Travels in India and Peru":—"I have been assured by Gironda and Martinez that there are three sorts of Calisaya: the 'Calisaya fina' (*Cinchona Calisaya v. vera*, Wedd.), the 'Calisaya morada' (*C. boliviana*, Wedd.), and the 'Calisaya verde' [*Cinchona Calisaya oblongifolia*]. They also told me that the last-named tree was a very large one, with leaves wholly devoid of any red colour on the nerves, and habitually growing very far down the valleys and even in the plains. A tree of this variety supplies 600 or 700 lbs. weight of bark, whereas the *Calisaya fina* yields only 300 to 400 lbs. Gironda declares that in the province of Muneças, Bolivia, he saw one that furnished 1000 lbs. of tabla, that is to say, of the bark, of the trunk, and lower branches." It is said that better results are to be obtained by cultivating the *Calisaya verde* than the *Calisaya fina*, because although the former yields only 6¼ to 9 per cent. of pure sulphate of quinine, yet as it yields twice the amount of bark as the *fina* or *Ledgeriana*, the produce of the *Calisaya verde* is equivalent to from 13 to 18 per cent. of quinine. "Moreover, from the fact that the *Calisaya verde* is a more vigorous tree than the delicate *Ledgeriana*, and will grow at a lower elevation, it is obvious that it can be cultivated to a much greater extent, and may be extremely valuable for grafting the *Ledgeriana* upon, more especially since the attempt to graft the *Ledgeriana* upon *C. succirubra* has proved unsuccessful."

A COMMISSION has been appointed in Paris composed of MM. Wurtz, Berthelot, and other influential men of science connected with politics, to establish a superior School of Chemistry and Physics. The course of instruction will occupy three years. It is stated that M. Cochery will devote to this institution the surplus of the International Exhibition of Electricity.

THE number of municipal services in Paris in which telegraphs or telephones are used is so large that the civic authorities have decided to establish a telegraphic examination for their *employés*.

AN interesting series of papers on the volcanoes of Japan has been commenced by Prof. Milne in the *Japan Gazette* of Yokohama. The articles are compiled almost wholly from native records, and while mentioning the particulars of the various eruptions within the historical period, will also refer to the legends and superstitions of the people respecting these phenomena. Prof. Milne mentions as a noticeable fact the association of many of the eruptions with some great calamity or other remarkable event. The mental effects produced by seismic phenomena have frequently been very curious. Thus an emperor orders the people to pray for forgiveness of their sins on account of an eruption; a governor presents a shrine to the deity of the mountain to prevent any further outbreaks; and priests are ordered to pray to a mountain to cease ruining the crops by pouring forth ashes. The writer also thinks that if the history of earthquakes and volcanoes were closely examined in other countries as well as Japan, these phenomena would be found to play an important part in engendering superstition and producing mental aberrations, traces of which may be met with in the forms of worship. The first of these papers, which is on Mount Aso in Kiushiu, one of the most remarkable volcanoes in the world, appeared on December 31. The series promises to be one of the highest scientific interest.

ON February 12 the new Natural History Museum was opened at Berne.

EARTHQUAKES are reported from Chieti and Castelfrentano, in the Abruzzi, where shocks were observed on February 12 a 3 a.m.

ON February 3 a remarkable fall of meteorites occurred in Transylvania. At Klausenburg an intense light suddenly flashed into view at 3.45 p.m. on that day, the sky being perfectly cloudless. The meteor was seen in the north-east part of the sky, and when it disappeared a white cloud was seen in its stead, which spread into a thin streak stretching from west to east. Soon afterwards a loud report was heard. The next day the news arrived that near Mocs, about twenty-five miles to the east of Klausenburg, some meteorites had fallen; one of these weighs 35 kilogrammes, and penetrated 68 centimetres deep into the ground. Two other pieces were found near Olah Gyeres, and five others near Vajda Kamaras. Prof. Koch collected no less than sixty pieces of smaller dimensions near Gyulatelke, Visa, and Bare to the north of Mocs. The direction of the meteor was from north-west to south-east, to judge from the position of the fragments; the latter were scattered over a line of about fifteen miles in length.

DR. SCHLIEMANN will continue his Trojan excavations this month as soon as the weather permits. The firman he has obtained permits him to extend his researches to the whole Troas. He will therefore not confine himself solely to Hissarlik, but will also closely investigate the environs of Balli-Dagh, where ancient Troy was situated, according to Le Chevalier's theory.

AT the instance of the Conseil d'Hygiène for the Department of the Seine, M. Delpech has drawn up an instructive report (*La Nature*) on the dangers arising from bees. The loss and inconvenience incurred by some sugar refineries in Paris through bee-keepers' establishments in the neighbourhood, attracted notice some time ago; at the Lay refinery the depredation is estimated at 25,000 francs a year, and the workmen, nearly naked, are often stung. The children (1200) at a school in the rue de Tanger, have suffered similarly to a large extent. M. Delpech gives information with regard to the bee's sting, notices three classes of injuries caused by it, and cites a number of cases in which it has proved fatal. Stings on the face are the most serious, the nerve-centres being so near. Bees are evidently not to be trifled with. On the triple score of material damage, great inconvenience, and very real danger, M. Delpech condemns bee-keeping in large centres of population.

AN interesting paper by Mr. F. J. Faraday on "Prehistoric Fishing," is published in "Anglers' Evenings" (Manchester). The

author has brought together much curious and useful information on the piscatory, as well as other habits, of our prehistoric ancestors, and with considerable ingenuity applies the method of evolution in tracing the progress and development of "the gentle art."

AT Steeten on the Lahn (near Runkel) interesting discoveries have recently been made in a cave. They consist of seven human prehistoric skeletons and animal remains. The latter must have belonged to the Tertiary period. They were found in such enormous quantities that several generations must be represented. The spot positively teems with remains of the Cave period, so that it is highly desirable that the State should order that more extensive scientific excavations be speedily made.

THE writer of the article on Lieut. Collet's work on the Compass in last week's NATURE, asks us to make the following correction: p. 383, col. 1, line 8 from bottom, delete "only," and in line 7, instead of "whereas it is three times as much in" read "which is about twice as much as in."

THE additions to the Zoological Society's Gardens during the past week include an African Brush-tailed Porcupine (*Atherura africana*) from West Africa, presented by Mr. J. Cheetham; a Black-necked Heron (*Ardea atricollis*) from Cape Colony, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Blossom-headed Parrakeets (*Palæornis cyanocephalus*) from India, presented by Mrs. Francis Fox; a Waxwing (*Ampelis garrulus*), European, presented by Mr. W. H. St. Quintin; a Carrion Crow (*Corvus corone*), British, presented by Mr. F. H. Worsley Benison; a Rhesus Monkey (*Macacus erythræus*) from India, a Bonelli's Eagle (*Nisaëtus fasciatus*), European, deposited; two Common Buntings (*Emberiza miliaria*), two Black-headed Gulls (*Larus ridibundus*), a Common Curlew (*Numenius arquata*), a Bar-tailed Godwit (*Limosa lapponica*), two Knots (*Tringa canutus*), British, purchased.

OUR ASTRONOMICAL COLUMN

THE EARLIEST DAY-LIGHT OBSERVATIONS OF STARS.—In No. 2616 of the *Astronomische Nachrichten* Prof. Winnecke has an interesting note on the question, Who first observed stars in full daylight? The credit of the observation has been generally accorded to J. B. Morin in 1635. Arago, for instance, says: "Il est evident que c'est à Morin qu'il faut remonter pour trouver la première observation authentique d'une étoile vue en plein jour;" Zach and many other astronomical writers have held the same opinion. Morin's observations are found in his work, "Longitudinum Terrestrium necnon Cœlestium nova et hactenus optata Scientia," first published, as it appears, in an extended form at Paris in 1638. At the end of March, 1635, he saw Arcturus half an hour after sunrise. This observation of Morin's appears to have been overlooked in France, since in May, 1669, we find Picard expressing his surprise that he had been able to observe the meridian altitude of Regulus thirteen minutes before sunset; his observation is printed in Lemonnier's "Histoire Céleste": "Le 3 mai (1669), hauteur méridienne de Regulus 54° 42′ 50″, cette hauteur méridienne fut prise en *plein jour* à 7h. 5m. du soir, environ 13m. avant le coucher du Soleil, ce qui ne s'étoit encore jamais fait." On July 23 following he observed the meridian-altitude of Arcturus, while the sun was 17° above the horizon, and speaks of the observation as a remarkable one, concluding: "il est maintenant facile de trouver immédiatement les Ascensions droites des Etoiles fixes non seulement par les horlogès à pendule, mais aussi par l'observation du vertical du Soleil au même temps qu'on observera la hauteur méridienne d'une etoile fixe."

Prof. Winnecke points out that Morin was preceded in his discovery that the stars may be observed in daylight by more than one person. In a letter written from Amsterdam to Gassendi, by Martinus Hortensius, and dated October 12, 1636, he mentions that observations such as Morin had claimed to be the first to make, were by no means new to him, and from the dates of the publications in which he records his own observations it is clear that his claim of priority to Morin is justified, though when his earliest observation was made cannot, as Prof. Winnecke remarks, be certainly inferred. Schickard, Professor of Hebrew and Mathematics at Tubingen, whose first work, the "Astroscopium," appeared in 1623, and was frequently reprinted, saw Arcturus in broad daylight as early as 1632. In the "Historia Cœlestis, ex observationibus Tychonis Brahe," by Albertus Curtius, at p. 956 we read: "1632 Martii 2. Nota. Cor Scorpii claro die adhuc à me visum per conspicilia tamen cum Saturnus ægre cognosceretur: nec aër fuit omnino purus."

Prof. Winnecke concludes that Schickard, as well as Hortensius, had observed fixed stars in daylight previous to Morin, who, as we have said, has been generally credited with this advance in astronomical observation.

BINARY STARS.—Mr. J. L. Casey, U.S.A., has calculated first approximations to the orbits of φ Ursæ Majoris and Σ 1757 (Piazzi xiii. 127). The former is one of O. Struve's discoveries, his first and last published epochs being—

1842·34, Pos. 4°·4, Dist. 0″·46.
1875·48, „ 295°·5, certainly oblong.

The apparent motion being direct, or with increasing angles, these indicate a change of 290° in thirty-three years.

Σ 1757 was measured by Struve in 1825. For comparison with his first epoch, we add Prof. Asaph Hall's for 1879—

Struve, 1825·37, Pos. 10°·0, Dist. 1″·60
A. Hall, 1879·40, „ 68·9, „ 2·34

The elements are as follow:—

	φ Ursæ Majoris.		Σ 1757.
Periastron passage	1877·12	...	1797·42
Node	105° 18′	...	344° 43′
Node to periastron	72° 7′	...	315° 28′
Inclination	57°5 7′	...	29° 32′
Excentricity	0·788	...	0·5079
Semi-axis major	0″·54	...	2″·29
Period	115·4 years.	...	401·0 years.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday last, Major J. E. Sandeman, B.S.C., read a paper on recent explorations of the sources of the Irawaddy. He referred first to Mr. R. Gordon's able report on the hydrology and hydrography of the river, in which the old theory of the Saupo, or great river of Tibet, being the main source of its vast stream, is revived, and then to what has lately been done, showing that the Saupo more probably unites with the Kihong. Major Sandeman next dealt with some endeavours to reach the source of the Irawaddy, more especially that made by a Burman named Alaga, who had been trained by himself. This man started from Bhamo in October 1879, and was absent six months. He brought back a good deal of information respecting the western and eastern branches of the Irawady, but we cannot see how he can be said to have explored their sources. It was somewhat unsatisfactory to learn that "political considerations"—the old Indian bugbear—prevented Major Sandeman from stating why the explorer was compelled to turn back before doing what he was sent to do. Though the geographical results of Alaga's journey are not what might have been expected, he has brought back some very interesting information regarding the domestic habits, religious customs, &c., more particularly of the Kachins, or Kakhyens. In concluding his paper Major Sandeman summed up the various attempts which have heen made to reach the sources of the Irawaddy, and to discover the true outlet of the Saupo.

COL. VENIUKOF has informed the French Geographical Society that M. Lessar, a Russian engineer officer, has completed the levelling of the country between Askabad and Sarakhs. This operation has proved the practicability of constructing a railway between these two places, and even for some forty miles beyond Sarakhs, in the valley of the Heri-rud (Tejend). It is estimated that the cost would not exceed 320,000*l.* At the same time M. Gladycheff, the astronomer of the expedition, has determined the geographical position of thirteen points between Askabad, Sarakhs, and Meshed. At Meshed he is said to have purchased the plan of the town which Mr. E. O'Donovan had made, but apparently lost. Perhaps Mr. O'Donovan may enlighten us on this point, when he gives his account of his varied

experiences in the Merv region at the Geographical Society's meeting on March 27.

Dr. A. E. Regel, well-known through his travels, undertook a new journey to Central Asiatic districts which have never been visited by a European before, and has now returned richly laden with scientific treasures. He began his work with an investigation of the Matchi Valley near the Zarawshan glaciers, crossed the mountain passes of Pakchif and Sagridetch, and reached the towns of Kala and Chumba, which stand upon the high plateau of the Amu Daria. Concerning this part he made interesting ethnographical observations. The type of the population of these districts is a mixed one; in Darwas the type of Aryans has remained pure, yet the hair is not always black, lighter shades being frequently met with; sometimes the head is completely shaved. The women do not cover their faces and marry according to their choice; their faces are almost European in appearance, sometimes gipsy like. The language at Darwas varies but little from that spoken at Bokhara and Samarkand. Quite another language is found at Shugnan, which sounds almost like a European language, as do also the national songs of these people.

A Russian staff-officer, who is said to have followed Col. C. E. Stewart's example by disguising himself as a merchant, and appears to have been recently travelling about in Khorassan, has published in the *Nouveau Temps* some interesting papers on the country and its Kurdish inhabitants.

Captain von Wohlgemuth, of the Austrian Navy, has been appointed leader of the Austrian Polar expedition to establish an observing station at Jan Mayen. The steamer, which will leave Pola early in April next, is now being fitted out most energetically.

The Geographical Society of the Pacific, founded at San Francisco last summer, have just issued the first number of their *Proceedings*, which is entirely occupied by a paper prepared for the Society by Capt. Hooper, on the recent cruise of the *Corwin* in the Arctic Sea. In addition to the account of his visit to Wrangel Land, &c., Capt. Hooper gives some details as to the manners and customs of the Chukches. Capt. Hooper proposes to deal with the very important subject of currents in another paper, but he makes a few remarks on the influence of the Kuro-siwo or Japanese warm stream on the waters of Behring Strait, &c.; and he also furnishes a table showing his determination of the magnetic declination and dip in the Arctic regions, from the end of May to the beginning of October, 1881.

The new number of the American Geographical Society's *Bulletin* contains an account by Commander H. H. Gorringe U.S.N., on a cruise along the northern coast of Africa, and a paper by Mr. Jas. Douglas, jun., on the Geography, People, and Institutions of Chile.

ON THE SENSE OF COLOUR AMONG SOME OF THE LOWER ANIMALS[1]

As I have already mentioned in a previous communication (*Journ.* Linn. Soc. vol. xv. p. 376 (Part No. 87), M. Paul Bert (*Archiv. de Physiol.* 1869, p. 547) has made some very interesting experiments on a small freshwater crustacean belonging to the genus *Daphnia*, from which he concludes that they perceive all the colours known to us, being, however, especially sensitive to the yellow and green; and that their limits of vision are the same as ours.

Nay, he even goes further than this, and feels justified in concluding, from the experience of two species—Man and *Daphnia*—that the limits of vision would be the same in all cases.

His words are:—

A. "Tous les animaux voient les rayons spectraux que nous voyons."

B. "Ils ne voient aucun de ceux que nous ne voyons pas."

C. "Dans l'étendue de la région visible, les différences entre les pouvoirs éclairants des différents rayons colorés sont les mêmes pour eux et pour nous."

He also adds that, "puisque les limites de visibilité semblent être les mêmes pour les animaux et pour nous, ne trouvons-nous pas là une raison de plus pour supposer que le rôle des milieux de l'œil est tout-à-fait secondaire, et que la visibilité tient à l'impressionnabilité de l'appareil nerveux lui-même."

[1] Paper read at the Linnean Society on November 17, 1881, by Sir John Lubbock, Bart., M.P., F.R.S., President.

These generalisations would seem to rest on a very narrow foundation. I have already attempted to show that the conclusion does not appear to hold good in the case of ants, and I determined therefore to make some experiments myself on Daphnias, the results of which are embodied in the present communication.

Prof. Dewar was kind enough again to arrange for me a spectrum, which, by means of a mirror, was thrown on to the floor. I then placed some Daphnias in a wooden trough 14 inches by 4 inches, and divided by cross partitions of glass into divisions, so that I could isolate the parts illuminated by the different-coloured rays. The two ends of the trough extended somewhat beyond the visible spectrum. I then placed fifty specimens of *Daphnia pulex* in the trough, removing the glass partitions so that they could circulate freely from one end of the trough to the other. Then, after scattering them equally through the water, I exposed them to the light for ten minutes, after which I inserted the glass partitions, and then counted the Daphnias in each division. The results were as follows:—

Number of Daphnias

	Beyond the blue.	In the red and yellow.	In the greenish yellow and green.	In the blue.	In the violet.	Beyond the violet.
Obs. 1. ...	0	20	28	2	0	0
" 2. ...	1	21	25	3	0	0
" 3. ...	2	21	24	3	0	0
" 4. ...	1	19	29	1	0	0
" 5. ...	0	20	27	3	0	0
	4	101	133	12	0	0

I may add that the blue and violet divisions were naturally longer than the red and green.

May 25.—Tried again the same arrangement, but separating the yellow, and giving the Daphnias the choice between red, yellow, green, blue, violet and dark:—

	Dark.	Violet.	Blue.	Green.	Yellow.	Red.
Exp. 1. ...	0	0	3	39	5	3
" 2. ...	0	1	2	37	7	3
" 3. ...	0	0	4	31	10	5
" 4. ...	0	1	5	30	8	6
" 5. ...	0	1	4	33	6	6
	0	3	18	170	36	23

Of course it must be remembered that the yellow band is much narrower than the green. I reckoned as yellow a width of ¾ inch, and that of the green 2 inches.

Again,

	Dark.	Violet.	Blue.	Green.	Yellow.	Red.
Exp. 1. ...	0	0	4	30	6	10
" 2. ...	0	1	3	25	8	13
" 3. ...	0	0	2	24	9	15
" 4. ...	1	0	3	25	8	13
" 5. ...	0	1	2	24	7	16
	1	2	14	128	38	67

M. Paul Bert observes (*l. c.*) that in his experiments the Daphnias followed exactly the brilliancy of the light. It will be observed, however, that in my experiments this was not the case; as there were more Daphnias in proportion, as well as absolutely, in the green, although the yellow is the brightest portion of the spectrum.

May 18.—The same arrangement as before. In order to test the limits of vision at the red end of the spectrum, I used the trough so that the extreme division was in the ultra-red and the second in the red. I then placed 60 Daphnias in the ultra-red. After five minutes' exposure I counted them. There were in the

	Red.	Ultra-red.
Exp. 1.	54	5
" 2.	56	4
	110	9

I now gave them four divisions—dark, red, ultra-red, and dark again. The numbers were:—

	Dark.	Red.	Ultra-red.	Dark.
Exp. 1.	5	47	6	2
" 2.	9	41	7	3
	14	88	13	5

It seems clear, therefore, that the ultra-red is to them practically the same as darkness.

I then so arranged the trough that the yellow fell in the middle of one of the divisions. The result was :—

Number of Daphnias

	Ultra-red and lower red.	Upper edge of red, yellow, and lower green.	Greenish blue and blue.	Violet.	Ultra-violet.
Exp. 1. ...	8	38	4	0	0
,, 2. ...	9	36	5	0	0
,, 3. ...	8	39	3	0	0
	25	113	12	0	0

I then shut them off from all the colours excepting red, giving them only the option between red and ultra-red :—

	Red.	Ultra-red.
Exp. 1.	46	4
,, 2.	47	3
,, 3.	44	6
	137	13

I then left them access to a division on the other side of the red, which, however, I darkened by interposing a piece of wood. This enabled me better to compare the ultra-red rays with a really dark space :—

	Dark.	Red.	Ultra-red.
Exp. 1.	4	43	3
,, 2.	3	45	2
	7	88	5

Certainly, therefore, their limits of vision at the red end of the spectrum seem approximately to coincide with ours.

I then proceeded to examine their behaviour with reference to the other end of the spectrum.

Ultra-violet.	Dark.
58	2
286	14

Not satisfied with this I tried to test it in another way.

I then shut them off from all the rays except the blue, violet, and ultra-violet. The result was as follows :—

Number of Daphnias

	Ultra-violet.	Violet.	Blue.	Dark.
Exp. 1.	1	9	38	2
,, 2.	4	6	38	2
,, 3.	0	2	46	2
	5	17	122	6

I then gave them only the option of ultra-violet, violet, and darkness :—

	Ultra-violet.	Violet.	Dark.
Exp. 1.	8	48	4
,, 2.	6	48	6
,, 3.	12	47	1
,, 4.	15	42	3
,, 5.	4	53	3
	45	238	17

I then tried ultra-violet and dark. The width of the violet was 2 inches; and I divided the ultra-violet portion again into divisions each of 2 inches, which we may call ultra-violet, further ultra-violet, and still further ultra-violet. The results were :—

Number of Daphnias

	Still further ultra-violet.	Further ultra-violet.	Ultra-violet.	Dark.
Exp. 1.	0	6	52	2
,, 2.	0	5	52	3
,, 3.	0	6	50	4
,, 4.	0	4	53	3
,, 5.	0	4	54	2
	0	25	261	14

May 18.—I then again tried them with the ultra-violet rays, using three divisions, namely, further ultra-violet, ultra-violet, and dark. The numbers were as follows, viz. under the

	Further ultra-violet.	Ultra-violet.	Dark.
Exp. 1.	6	50	4
,, 2.	3	55	2
	9	105	6

To my eye there was no perceptible difference between the further ultra-violet and the ultra-violet portion; but slightly undiffused light reached the two extreme divisions. It may be asked why the still further ultra-violet division should have been entirely deserted, while in each case two or three Daphnias were in the darkened one. This, I doubt not, was due to the fact that the darkened division being next to the ultra-violet, one or two in each case straggled into it.

I then placed over the ultra-violet division a glass cell containing a layer of sulphate of quinine about ⅜ inch in depth, and over the further ultra violet a similar cell with water. I had expected that the great majority would have collected under the water-cell. The numbers, however, were :—

	Further ultra-violet with cell containing water.	Ultra-violet with cell containing sulphate of quinine.
Exp. 1.	8	50
,, 2.	4	54
,, 3.	11	49
,, 4.	4	56
	27	209

The reason of this, however, seemed evident as soon as I tried the experiment; because though the sulphate of quinine stops the ultra-violet rays, it turns them into blue light, and, to our eyes at least, actually increases the brilliance.

I then took a cell in which I placed a layer of 5 per cent. solution of chromate of potash less than an eighth of an inch in depth, which, though almost colourless to our eyes, completely cut off the ultra-violet rays. I then turned my trough at right angles, so that I could cover one side of the ultra-violet portion of the spectrum with the chromate and leave the other exposed. The numbers were as follows :—

	Side of the ultra-violet covered with chromate of potash.	Side uncovered.	Dark.
Exp. 1.	5	55	0
I now covered up the other side.			
,, 2.	3	57	0
Again covered up the same side as at first.			
,, 3.	4	56	0
Again covered up the other side.			
,, 4.	3	57	0

May 19.—Again the same arrangement. I reduced the chromate of potash to a mere film, which, however, still cut off the ultra-violet rays. I then placed it, as before, over one-half of the ultra-violet portion of the spectrum, and over the other half I placed a similar cell containing water. Between each experiment I reversed the position of the two cells. The numbers were :—

	Under the film of chromate of potash.	Under the water.
Exp. 1.	8	52
,, 2.	4	56
,, 3.	10	50
,, 4.	7	53
	29	211

Evidently even a film of chromate of potash exercises a very considerable influence; and indeed I doubt not that if a longer time had been allowed, the difference would have been even greater.

It seems clear, therefore, that a film of a 5 per cent. solution of chromate of potash only ⅛ inch in thickness, which cuts off the ultra-violet rays, though absolutely transparent to our eyes, is by no means so to the Daphnias.

I then again returned to the sulphate of quinine; but instead of placing it close to the water, I suspended it at a height of 3

feet, so that the Daphnias were far less directly illuminated by the scattered light.

As in the preceding case, I placed by the side of it a similar cell containing water, and suspended them side by side over the water containing the Daphnias, and reversing the position after each experiment. The numbers were as follows:—

	Under the sulphate of quinine.	Under the water.
Exp. 1.	13	47
,, 2.	17	43
,, 3.	12	48
,, 4.	11	49
,, 5.	20	40
,, 6.	18	42
,, 7.	20	40
,, 8.	15	45
	126	354

Although the contrast in this latter series is not so great, still it is unmistakable. It seems to me, therefore, though I differ with great reluctance from so eminent an authority as M. Paul Bert, that the limits of vision of Daphnias do not, at the violet end of the spectrum, coincide with ours, but that the Daphnia, like the ant, is affected by the ultra-violet rays.

GLACIERS AND GLACIAL PERIODS IN THEIR RELATIONS TO CLIMATE[1]

NOW that the *effects* of glacial action, present and past, have been so well studied, the question as to *causes* deserves to be more attentively considered, and it seems that meteorologists must now take it in hand, having too long neglected it. A cursory glance on the present conditions of our globe shows us that cold alone will not produce permanent snow and glaciers when vapour of water is deficient. There are no permanent snow nor glaciers in the Verkhojansk Mountains in North-East Siberia, yet at the foot of them the mean annual temperature is below 4° F., and that of January below −56° F. The reason is that the snowfall is but small, and thus the snow is easily melted in summer. In New Zealand, on the contrary, owing to the enormous snowfall in the mountains, glaciers descend to about 700 feet above sea-level on the west side (lat. 43° S.). At this height the mean annual temperature must be about 50° F., and snowfall and frost are of rare occurrence, even in winter.

The great importance of an abundant supply of vapour admitted, and thus the necessity of surfaces covered by sea, what temperature of the surface of the seas is the most favourable to the production of glaciers? This depends certainly on the height above sea-level where the *nevé* is formed; but so far as we consider lowlands and moderate heights, say below 6000 feet, the surface temperature of the water should not very much exceed the freezing point, otherwise the vapour evaporated from the sea and condensed on the surrounding lands will be rain, and not snow, thus contributing rather to melt the existing snow and not to form new snow-layers. For lowlands and very small elevations a temperature of the surrounding seas of about 32° F. is that which is most favourable to the formation of snow, and if the last is falling in sufficient quantities to form permanent snow and glaciers.

The deeper and opener the seas are, the better, for such seas do not freeze entirely, as the winds and tides always break the ice which is already formed; thus seas of that kind have, even in the midst of winter, a considerable open surface, which evaporates freely. Shallow seas surrounded by land can be entirely frozen in winter, and thus the ice and snow which cover them, considerably cooled by radiation and cold winds from the land, evaporate but very little, and are by far less favourable to a great precipitation of snow and ice. Thus the cold of winter in mediterranean seas is a condition very unfavourable to a great evaporation from their surface in the cold season, and to a heavy snowfall on the surrounding land. With the premises given above it will be easy to understand the difference in the extent of ice-sheets and glaciers, or their total absence in the different regions of our globe at the present time, as well as the probable causes of former glaciation.

Abstracting for once from the polar regions of the southern hemisphere, of which we know but little, we see that in the higher latitudes of the southern hemisphere (40°–67°) the extent of seas is much greater than in the same latitudes of the northern hemisphere. We know, further, that the seas of these latitudes receive considerable quantities of warm water from tropical seas. Now the south tropical seas do not exceed so much in extent the north tropical seas, then the seas between 40°–67° S. exceed the seas between 40°–67° N. If the latter were even to receive the same relative proportion of warm water from the tropical seas of their own hemisphere than the southern seas of the same parallels, the thermal effect would be yet greater, on account of the limited extent of the seas between 40°–67° N. But the greater extension of the south-east trades and their existence even to the north of the equator pours a great quantity of the warm water of the southern tropical seas into the seas of the north temperate zone, thus giving probably an equal if not a superior quantity of warm water to seas of not half the extent. How much this must tend to raise the temperature of the seas between 40°–67° N. is easy to see. This explains why there is so little permanent snow in these northern latitudes in the proximity of the sea, notwithstanding the great precipitation existing there, and the greatest quantity of it falling in the colder part of the year. The temperature of the sea-surface is so high, that much more rain than snow falls even in winter. Let us take an example. The sea-surface between the south-west of England and the south of Ireland has a temperature of above 50° F. even in January. Supposing a saturated stratum of air to rise from these seas, it would have cooled down to about 38·4° F. at an elevation of 4000 feet, that is at the level of the highest peaks of the British Islands.[1] The resulting precipitation will be rain and not snow. Thus a broad and swift atmospherical current from the south-west will give rain and not snow, even in the mountains of England and Scotland. As the south-west are the prevailing winds the absence of anything like permanent snow is easily understood. In Norway, where the surrounding seas are colder and the elevations greater, permanent snow and glaciers do exist. Greenland, which is surrounded by much colder seas, yet never entirely frozen, has an ice-sheet covering all the interior and forcing glaciers to the sea. The height of the ice-sheet is so great, and the sea so cold, that probably even in summer the precipitation is always snow in the interior. As the seas near Greenland are not warmer than 41° F. in summer, a saturated stratum of air rising from them will have a temperature of about 31·1° F. at a height of 3000 feet, that is, much below the level of the ice-sheet in the interior.

The seas between 40–67° S. have generally a much lower temperature than the northern seas of the same latitude (see, for example, the map in Wild's "Thalassa.") Thus their conditions are much more favourable to the production of snow at small elevations above the sea-level, and owing to the small difference of the temperature of winter and summer in so strictly oceanic climates, snow will fall even in summer. This explains why we find so great sheets of ice and glaciers descending to sea-level in all lands and islands south of 50° S. (the eastern part of South America, the Falkland and Auckland Islands excepted).

As there is either a continent or a great cluster of high islands in high southern latitudes, and as the seas north of it give great quantities of moisture to be condensed to snow, a glaciation exceeding all that is known in the north hemisphere is the result, and the glaciers, descending to the sea, and their broken ends floating to the ocean as icebergs, they in their turn cool the sea water, and thus bring about temperatures favourable to the formation of snow. Thus cause and effect react on each other, as is so often the case. We know besides that the southern seas do not freeze to a great extent, so that ice-fields, so frequent in higher northern latitudes, are far less common in the south, the icebergs being the prevailing form of ice there. This shows us that there is, on the southern seas, always a great extent of open water, and thus an active evaporation.

In the northern hemisphere, on the contrary, the colder seas are mostly shallow and surrounded by land, and thus frozen over to a great extent in winter (for example, the White and Kara Seas, the Sea of Okhotsk, Hudson's Bay, the bays and straits between the archipelago of North America). Thus the evaporation is checked just at the time most favourable to a heavy snowfall.

The continents of the northern hemisphere are too extensive, too little open to the influences of the sea and its moisture, to have extensive ice-sheets. The example of mountains in North-East Siberia shows this very well. Similarly the great interior

[1] Short analysis of my paper under the same title, published by the *Zeitschrift der Gesellschaft für Erdkunde* in 1881.

[1] On the Thermal Conditions of Rising and Descending Strata of Air. See Guldberg and Mohn's "Etudes sur les Mouvements de l'Atmosphère."

plateaux in the centre of Asia, north of the Karakoram and east of the Pamir, are too dry for glaciers, notwithstanding the height of the mountains rising over them. The continental parts of Eastern Asia (that is China, Mandchooria, the Amoor provinces, &c.) have more moisture, but it falls nearly entirely in summer, and, owing to the high temperature of the continent at this season, rain, and not snow, prevails to the height of 12,000 or even 15,000 feet. The winter is the time of the north-west monsoon, which brings cold but dry weather, with a cloudless sky. The monsoon climate of these regions, that is the prevalence of cold, dry winds in winter and moist winds in summer, being the result of the geographical conditions, it must have prevailed since the great features of the centre and east of Asia were as they are. The existence of the plateaux and elevations to the south and west of them is especially important. As all geologists are agreed that at least since the Pliocene period this has been the case, I must conclude that the monsoon climate existed in Eastern Asia the whole time, and thus conditions exceedingly unfavourable to an accumulation of permanent snow and glaciers. It is well known that Pumpelly and Baron Richthofen did not find any traces of former glacier action in China or on its western and northern borders; neither did Dr. Schmidt find any in the Amoor provinces. Thus geological and climatological evidence are perfectly agreed, the first showing that there were no glaciers, and the second why there were none. As to the plateaux of Central Asia, they must have been exceedingly dry since the rise of the Himalaya and Karakoram to the south and the Pamir heights to the west of them, and thus have had nothing corresponding to the later glacial periods of Europe and North America. The geological evidence, especially the studies of Stoliczka, confirms this.

As to the former glaciation of Europe and North America, the conditions which must have led to it are, in general, greater cold in regions which have now an oceanic climate with heavy precipitation, and a more oceanic climate in regions which are cold enough, but where the rain and snow are now too deficient, especially in the cold season. Great Britain belongs certainly to the former class, that is, there is moisture enough, but, owing to the warm seas surrounding the islands, the temperature is too warm for glaciers. Thus a diminution of the quantity of warm water brought from the tropical Atlantic, or a change of these currents so as to stop their influence on Great Britain altogether, are the principal conditions needful to bring about a heavy snowfall, first in the mountains, and then even on more moderate heights, and to render the snow persistent. A change of the same kind would increase the present glaciers of Norway, enabling them to reach the sea even south of the 60° N., and give rise to new glaciers.

It is now pretty certain that all Scandinavia, Finland, North-West Russia, and Northern Germany were covered by a sheet of ice which gradually filled the Baltic and North Seas and reached west of Great Britain, to where the depth of the Atlantic is now about 600 feet. Many geologists would have the whole extent of country standing much higher to initiate such an intense glaciation. I would not object to this for the mountainous districts, those of Scandinavia especially; but there is decidedly no proof of it for the plains, and the arguments from a climatological point are strongly against such a supposition. A rise of less than 600 feet in North-West Europe would empty the Baltic and North Seas, and extend the Continent to much beyond Ireland. This would give to Königsberg in Prussia a climate as continental as that of Orenburg on the borders of the Kirghiz steppes. Such a dry climate would be so unfavourable to permanent snow and glaciers, that no amount of rise of the land would outweigh it.

I suppose, on the contrary, that a rise of the seas or a sinking of the land had very much increased the extent of country covered by the sea, and besides giving access to the cold water and ice of the Arctic Ocean through what now are the Lakes of Ladoga, Onega, and the White Sea, brought a moist and cold climate to the whole region. Thus an accumulation of snow and ice was brought about first on the highlands, and the ice by and by expelled the waters of the shallow seas (the present lowlands of North-West Russia, Scandinavia, and North Germany) and then of the somewhat deeper seas (the present Baltic and North Seas). As the ice advanced, the elevation of its interior part and the cooling due to the presence of snow and ice counterbalanced the greater distance of the sea, favouring a heavy snowfall even in summer, *i.e.* giving the conditions which now exist in the interior of Greenland.

Similarly in North America the submersion of a part of the Western plains, uniting Hudson's Bay to the Gulf of Mexico, was necessary to the beginning of intense glaciation. A vast extent of cold sea was thus called into existence in the West, and as the westerly winds are very prevalent and strong there, this must have caused a heavy snowfall during the greater part of the year. It is known that even now the precipitation of rain and snow is very heavy in the United States and part of Canada from the Atlantic to the Mississippi, so heavy that it it is unequalled by any extensive region of the globe under the same latitudes. Besides, the cold sea to the West went far to prevent the influence of the hot and dry summer temperature on the plains between the Rocky Mountains and the 100° W. or even beyond. American geologists have shown how closely the ice-sheet conformed to the present amount of precipitation, there being a "driftless" region in Wisconsin, which is now drier than the surrounding country, having less than thirty-two inches of precipitation in the year, and of four in winter.[1] The same relation is to be found in the Old World wherever the phenomena are better studied; glaciation was more extended in the moister Western Alps than in the drier Eastern Alps; it was less in the Caucasus and Central Asia (*i.e.* the part west of the Pamir and Thian-Shan) than in the Alps, &c.

I have now to consider the possibility of so-called ice-caps reaching in an unbroken sheet from the Pole to a latitude of 45°–50°. All I mentioned before leads to the conclusion that they are impossible, as on extensive and deep seas an accumulation of ice is impossible, as the ice is immediately broken by winds, currents, and tides, and on great continents the climate is too dry. Thus now there is nothing like an extension of ice of that kind in the southern hemisphere, because the greatest part of the latitudes above 45° are open ocean, and on the northern because the continents are too dry. And the one or the other cause always must have prevented an extension of ice of a magnitude as stated above, and mostly probably there were both too extensive continents and too great and deep oceans to allow of an accumulation of ice on a very great part of them at the same time. Thus a displacement of the centre of gravity due to ice of the magnitude supposed by Mr. Croll on this hypothesis, is inadmissible. But one thing is worthy of remark in this hypothesis: it is the search for a cause which may explain the changes of the level of the sea, which certainly have taken place on the globe, and which are now explained as due to the rise or subsidence of the land on the Lyellian hypothesis of the stability of the sea-level.

The influence of a high eccentricity on the accumulation of snow and glaciers has next to be considered. This is a question which has been considered especially by British geologists, and the majority of them agree in attributing a great influence to that cause, and in thinking that with the winter in aphelion during a high eccentricity there existed conditions favourable to an accumulation of ice.

Let us take the simplest conditions, those in the interior of a great continent, for example, Asia. We should expect then, during high eccentricity, a greater cold in mid-winter, and greater heat in midsummer when winter is in aphelion. A greater cold in winter would not be conducive to an accumulation of snow, while a more intense heat in midsummer would probably melt the snow at heights where at present temperature does not rise much above 32° F. In the monsoon regions a colder winter in the interior, with the accompanying higher pressure of the air, would intensify the cold and dry winter monsoon winds, and thus bring about conditions even less favourable to an accumulation of snow. Greater heat in summer in the interior of Asia would intensify also the moist summer monsoon, and thus give a greater amount of precipitation. But owing to the small amount of snow falling in winter and its rapid melting, the temperature would rise over 32° F., even at considerable heights, greater than now, and the precipitation due to the moist winds would be rain. Thus, in the interior and eastern part of a continent like Asia, winter in aphelion during a high eccentricity would be less favourable than even the present conditions to permanent snow and glaciers.

As to the western parts of continents and to islands, they are more fully under the influence of the seas. As there is no reason to suppose that the surface-temperature of the sea would be lower during winter in aphelion and high eccentricity, it follows that there will not be more snow than now in countries where rain is the rule, even in winter, all other things equal. As

[1] A. Dana in *Sill. Journ.* c. xv. p. 250.

there is also nothing in these astronomical changes to intensify the moist (principally westerly) winds in winter, there will also not be a greater quantity of snow falling at that season in regions having a regular covering of snow in winter. The greater heat and rarefaction of the air in the interior of continents in summer will cause the air of the oceans to flow thither with greater force, and such a movement of the air is favourable to more abundant summer rains than are experienced now, and thus to a melting of the snow in mountainous countries.

Thus it would seem that winter in aphelion during high eccentricity would have rather the opposite effect to that which is generally attributed to it, but it seems to me that the effect would be in any case but slight, and not by far to be compared to that of the distribution of land and sea, mountains and lowlands; in other words, to that of the geographical conditions. With the change of these the extent and distribution of snow and ice must change also.

An attentive study of the physical geography of the earth and of its influence on climates, together with a judicious application of the simplest physical theories, will enable us to gain by and by a better knowledge of geological climates. The problem is an arduous one, but now that the studies are directed in the right way, there is no doubt of the final success.

A. WOEIKOF

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

AT a recent meeting of the trustees of the Mason College in Birmingham, the executors of Sir Josiah Mason presented a statement showing the amount to which the college will be entitled under the will of Sir Josiah Mason. After paying claims on the estate and providing for legacy duty, about 20,000*l.* will accrue to the college within the next three years, and after certain life interests are satisfied, a further sum of about 15,000*l.* will be available, making a total of 35,000*l.* for the estate. The benefactions of Sir Josiah Mason to the college building, endowment, and legacies will then amount to a total of 210,000*l.* The building and endowment of the orphanage and almshouses represent a sum of about 260,000*l.*

IN our University Intelligence last week, in the paragraph relating to Prof. MacAlister's lectures, the word *chemical* should have been *clinical*.

SCIENTIFIC SERIALS

The American Naturalist, December, 1881, contains—F. M. Endlich, on Demerara.—C. E. Bessey, a sketch on the progress of botany in the United States in 1880.—J. D. Caton, the effects of reversion to the wild state in our domestic animals.—W. R. Higley, on the microscopic and general characters of the peach tree affected with the "yellows" (concluded).—W. H. Dall, on intelligence in a snail.

January, 1882.—S. A. Forbes, on the blind cave-fishes and their allies (a new species of Chologaster, *C. papilliferus*, from a spring in Southern Illinois, is described).—Dr. C. F. Gissler, on a singular parasitic Isopod (*Bopyrus palæmoneticola*, Packd.), and on some of its developmental stages (this interesting species, which is figured, was found on about 10 per cent. of the common prawns (*Palæmonetes vulgaris*) examined.—William Trelease, on the heterogony of *Oxalis violacea*.—J. M. Anders, Forests, their influence upon climate and rainfall.—A. S. Packard, jun., glacial marks in Labrador (with a plate).

THE last number of the *Journal of the Russian Chemical and Physical Society* (vol. xiv. fasc. 1) contains, besides the minutes of proceedings, papers on the constitution of compounds of the indigo group, by M. Lubavin; an interesting paper on the influence of molecular weight of homologues in the so-called incomplete reactions, by Prof. Menshutkin; on Caucasus naphtha, by MM. Markovnikoff and Ogloblin; on the distribution of magnetical currents, by M. Sloughinoff; and on the electromagnetic theory of light of Wm. Maxwell, by M. Borgman.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 26.—"An attempt at a Complete Osteology of *Hypsilophodon Foxii*," by J. W. Hulke, F.R.S. Abstract.

After a reference to papers descriptive of parts of the skeleton of this dinosaur, by Professors Owen, Huxley, and himself, the author gives a detailed description of the skull, vertebral column, shoulder, and hip-girdles, with their appendages. The skull is essentially lizard-like, both in its general form and in its structural details. The frontal is a paired bone. The premaxillæ send upwards mesial processes separating the external nares; the exclusion of the maxilla from these nares by the external ascending process of the premaxilla is apparent more than real, since the maxilla is prolonged forwards beneath this process, and comes into close proximity to the nostril. The supra-occipital enters into the foramen magnum. The palate fissured nearly in its whole length is strictly lacertilian. The presence of simple cylindrical teeth in the premaxillæ, of small, compressed teeth in the front of the maxilla and in the mandible, and of larger, more complex, compressed teeth behind these, foreshadow the incisors, premolars, and molars of the higher vertebrates. The vertebræ are opisthocœlous in the neck, planocœlous in the trunk and loins, and amphicœlous in the tail. In the neck and thoracic region of the vertebral column the ribs are forked. In the loins a simple unforked riblet is anchylosed to the end of the transverse process. The sacrum comprises five vertebræ. The ilium has a very long preacetabular process. The femur is shorter than the tibia; the inner trochanter is long and acutely pointed. The tibia has a stout præcnemial crest. The tarsus consists of two bones that together form a sinuous hollow upper surface, in which the tibia and fibula rest; the outer bone representing the os calcis supports both bones of the leg, whilst the inner, representing the astragalus, bears the tibia only. In two feet evidence of two elements of a distal row of tarsalia was found in the outer side of the foot. There are four functional toes with 2, 3, 4, 5 phalanges counting from the inner side of the foot, and a styliform rudiment of an outer metatarsal, devoid of phalanges. This alone demonstrates the generic distinctness of *Hypsilophodon* from *Iguanodon* in which, as is well known, the hind foot comprises only three functional toes. The ungual phalanges are sharply pointed. The sternum is rhomboid. The scapula and coracoid have a general resemblance to those of Iguanodon. The humerus has a considerable deltoid crest, and is shorter than the femur. The radius and ulna are shorter than the humerus. The ungual phalanges of the digits resemble those of the hind toes, but are smaller.

Physical Society, February 25.—Prof. G. C. Foster in the chair.—New Members: Prof. G. F. Fitzgerald, Trin. Col. Dublin, Mr. C. Richardson, Lieut. H. J. Dockrell, R.N., Mr. W. Ford Stanley, General H. Hyde, R.E., Mr. J. Buchanan.—Prof W. E. Ayrton, F.R.S., read a paper on Faure's accumulator, giving the results of experiments made by him and Prof. Perry on the efficiency, storing-power, and durability of the battery. The efficiency was got by measuring the power put in, and comparing it with that taken out, by means of Perry and Ayrton's voltameter and ammeter. The authors found that the cell has great resuscitating power if left insulated after all the current appears to have been discharged. Care had to be taken to see that the cell was quite discharged by letting it stand on open circuit for intervals and discharging between whiles. When this was done they found that the total loss for charges up to one million foot pounds need not be greater than 18 per cent. With slower charges they got a loss of only 10 per cent. As to the storage, a mean current of 18 amperes gave, after eighteen hours' discharge (six hours on three consecutive days), 1,440,000 foot pounds of work equivalent to 1 horse-power in forty-three minutes. The cell contained 81 lbs. of red lead, thus making a capacity of about 18,000 foot pounds per lb. of red lead. The cell showed no deterioration after two months of work.—Prof. Ayrton then described a new form of his dispersion photometer, which greatly reduces it in size and convenience. The principle of this instrument has already been described to the Society by the author. It consists in using a concave lens to disperse the stronger light, and thus obviate the necessity of putting it at a great distance if it is very powerful, such as an electric light. The powers of the two lights are compared by the eye in estimating the intensity of the shadows of a rod thrown on a white screen of blotting-paper by the two lights simultaneously. A sperm candle is used as the standard, and it is placed on a movable stand at an angle to the path of the other beam through the lens. Both the lens and candle can be shifted to and from the screen along a scale giving their distances, and the stronger beam is reflected from a small mirror. This mirror is ingeniously fixed so as to reflect the ray from the

same part of its surface whatever angle it is placed at, and thus the power of an electric light can be accurately given for every angle along which the ray travels from the lamp. Observations are taken through red and green glasses to get a better measure of the power of the light. Prof. Ayrton has found that ordinary air absorbs the green rays of the electric light very strongly, and hence, in order to get a proper test of an electric lamp, the photometer should not be far from the light. The new dispersion photometer shown is the only one admitting of this precaution. Mr. Shoolbred stated that he had found from experiment that the carbons of the Swan and Maxim incandescent lamps bore a much higher current without breaking when fed from a Faure accumulator than from a dynamo-electric machine. Prof. Ayrton corroborated this statement, and said that he had obtained a light of 800 candles from a Maxim lamp fed by an accumulator.—Prof. Sylvanus Thompson then read a paper on the electric resistance of carbon under pressure. It was generally stated that the resistance of carbon diminished under pressure, but he had found from recent experiments that the diminution observed was really due to the contact between the electrodes and the carbon. Under pressure there are more points of contact between the metal and carbon than without pressure. The result has an important bearing on the action of the carbon relay, rheostat, and microphone transmitter.—Prof. Ayrton pointed out that as carbon apparently diminished in resistance under a rise of temperature, this would seem to indicate it as a compound substance, since only simple substances seemed to increase in resistance with rise of temperature. Prof. Guthrie recalled that Dr. Moser had suggested that the alteration of the resistance of selenium under light was an effect of contact.—A paper by Mr. G. Gore was read, on the influence of the form of conductors on electric conductive resistance. His experiments were designed to show whether there was a difference of resistance in certain liquid conductors under the positive and negative current. None was discovered.—Dr. Hopkinson, F.R.S., read a paper on the refractive index and specific inductive capacity of transparent insulating media. He inferred from tried experiments and the electromagnetic theory that glass had a high refractive index for rays of very long wave-length. Dr. J. H. Gladstone suggested that the point should be tested by experiment, and that the method of photographing the red rays might be employed.—Mr. J. Macfarlane Gray explained that an objection to one result of his former communication to the Society, on the specific heat of steam, was really a confirmation of it, as Regnault's value was erroneous.

Chemical Society, February 16.—Prof. Roscoe, president, in the chair.—During the evening it was announced that the Council proposed Dr. Gilbert as the president for the coming year, Dr. Schunck and Mr. Griess as vice-presidents, and Drs. Atkinson and Japp, Capt. Abney, and Mr. O'Sullivan, as Members of Council, instead of Dr. Tidy and Messrs. Carteighe, Roberts, and Warington.—The following papers were read:—On benzylphenol and its derivatives, Part 2, by E. Rennie. The author has obtained and studied the following derivatives:—benzylphenol-sulphonic acid, mononitrobenzylphenol, amidobenzylphenol, dinitrobenzylphenol, nitrobromobenzylphenol. The same nitrobromo derivative is obtained whether nitric acid acts on the potassium bromosulphonate or bromine acts on the potassium nitrosulphonate. The formulæ of these substances must therefore be symmetrical. Benzylphenol is therefore a para derivative. The author quotes other evidence in support of this view.—On the Buxton thermal water, by J. C. Thresh. The author has made a most complete analysis of this water, and gives full details as to the methods employed.—On retrograde phosphates, by F. J. Lloyd. It has been long known that in some superphosphates the percentage of soluble phosphate originally present gradually decreases. The phosphate which has become insoluble is termed retrograde phosphate. The author has compared the different solutions recommended by Fresenius, Petermann, &c., for extracting these phosphates; he concludes that a cold ammoniacal solution of ammonium citrate containing 30 per cent. of citric acid is the most suitable solvent.—Contributions to the knowledge of the composition of alloys and metal work, for the most part ancient, by W. Flight. This paper contains analyses of some copper nickel coins of Bactria; some coins of ancient India, about 500 B.C., containing silver, copper, lead, &c.; a figure of Buddha, containing 4 per cent. of silver chloride; "Bidrai" ware and "Koft Gari" work from India; some iron and bronze implements from the Great Pyramid; copper spear-heads from Cyprus; a Hebrew shekel, various old Roman bronzes, &c.—On the dissociation of chlorine, by A. P. Smith and W. B. Lowe. The authors consider that their experiments prove that 1 gramme of chlorine at 6° C. becomes 0·744 grm. of chlorine at 1030° C.

Meteorological Society, February 15.—Mr. J. K. Laughton, M.A., F.R.A.S., president, in the chair.—The following gentlemen were balloted for and duly elected Fellows of the Society:—W. Aronsberg, J.P., W. G. Birchby, J. Rand Capron, F.R.A.S., P. Crowley, F.Z.S., W. W. Culcheth, M.Inst.C.E., D. Cunningham, M.Inst.C.E., F.S.S., S. Cushing, W. N. Greenwood, E. Kitto, J. Mansergh, M.Inst.C.E., G. Oliver, M.D., H. S. H. Shaw, Assoc.M.Inst.C.E., G. W. Stevenson, M.Inst.C.E., F.G.S., and W. H. Tyndall.—The papers read were:—Notes of experiments on the distribution of pressure upon flat surfaces perpendicularly exposed to the wind, by C. E. Burton, B.A., F.R.A.S., and R. H. Curtis, F.M.S. In the present state of aero-dynamics it seems to be impossible to make an *a priori* investigation of the distribution of pressure on a surface exposed to the impact of the fluid in motion without introducing such limitations as render the solutions arrived at widely divergent from the results obtained by the experiments hitherto made. The authors therefore proposed to themselves to attack the problem from the experimental side only, by a method which, as far as they know, has not been applied in the case of air, viz. the application of Pitot's tube, suitably modified in form to the simultaneous measurement of the pressures at the centre and at any en-centrically situated point of a pressure plate of known dimensions. The results of the preliminary experiments are given in the present paper.—The principle of New Zealand weather forecasts, by Commander R. A. Edwin, R.N., F.M.S.—The high atmospheric pressure of the middle of January, 1882, by H. Sowerby Wallis, F.M.S.—The electrical thermometer lent by Messrs. Siemens' Bros. for observing the temperature of the air at the summit of Boston Church Tower was also exhibited.

EDINBURGH

Royal Society, February 6.—Prof. Balfour, vice-president, in the chair.—Mr. John Aitken, in a paper on the Colour of the Mediterranean, and other waters, described a series of experiments which he had made last year as to the cause of the brilliant blue colour so characteristic of the Mediterranean and the Lake of Geneva. Two distinct theories had been advanced. The one explained the colour as due to reflection from small suspended particles which did not reflect the lower rays of the spectrum; the other as the result of the absorbent action of the water itself upon the white light before and after reflection from these particles. The former was shown to be inconsistent with the facts established by experiment, which could be fully explained upon the latter theory. The greater the number of white reflecting particles the greener the water appears to be, a fact which sufficiently explains the gradual deepening of the green to blue as one recedes from the shore. The waters of the Lake of Como owe their darkness to the absence of reflecting particles, as Mr. Aitken very ingeniously proved by scattering finely divided chalk in the centre of the lake, thereby producing a most brilliant blue. The brilliancy depends greatly on the colour of the suspended particles; and observations in other parts of the earth's surface go far to show that great brilliancy is usually found where white sand lines the shore. Thus the dullness of tint in our waters is to be referred to the dull colour of the small suspended particles. The author had also extended his observations to spring water, which was found to vary greatly in colour from dingy yellow to emerald blue. The paper was illustrated by experiments bearing out the views expressed, and led to a considerable discussion amongst the Fellows.—The Rev. Prof. Duns, D.D., read a paper on the surface geology of Middle Lochaber, giving a description of the peat, sand, gravel heaps, angular *débris* and boulders, which occur between the rivers Spean and Nevis, and along the west slopes of the Nevis Mountains. The paper was chiefly devoted to the boulders, their mineral character, size, position, angle to horizon, and striation being particularly noted. It was shown that the peat had been formed after the deposit of the sands and gravels, that the boulders occur *on* not *in* the heaps, that the position of boulders in the plain may have as much significance as those on mountain slopes, that all the characteristic glacial markings abound in this district, and that the bulk of the phenomena may ultimately be explained by the recognition of two movements—one outwards from Ben Nevis as a centre, and another (and preceding) inwards from the west, north-west,

or north-north-west.—Prof. Chrystal, in some suggestive remarks on dielectric strength, pointed out the error into which certain experimenters had fallen in imagining that the dielectric strength of a medium is at all determined by the maximum difference of potential that could exist between two conductors placed in it, the truth being that it depends on the dielectric tension (in Faraday's sense), that is, upon the resultant electric force or surface density at the point of rupture; and, in reference to this, described some experiments which he had lately carried out in conjunction with Dr. Macfarlane. From these it appeared that the difference of potential necessary to make a spark pass between two charged balls was greater in the neighbourhood of a positively charged body, and less in the neighbourhood of a negatively charged body than when no such body was present. A strong magnetic field, on the contrary, had no effect on the dielectric strength of air, whether the lines of magnetic force were in the direction of or perpendicular to the direction of the electric force—even though the strength of the field was as much as 6000 absolute units. The main part of the paper was taken up with a discussion, from the Faraday and Maxwell point of view, of the experiments of Thomson, Macfarlane, De la Rue, and Baille. Amongst other theoretical considerations the effect of a particular variation in the specific inductive capacity was investigated. The "water-electrometer," with which he and Dr. Macfarlane had made some measurements last year, was referred to as being in all probability an effective and accurate instrument of research in electrostatic experiments—being at all events handier and more rapidly worked than an absolute electrometer of the ordinary construction. The results obtained by it he hoped ere long to lay before the Society.—A Latin diagnosis of new and little known phanerogamous plants collected in Socotra by Prof. Bayley Balfour was laid on the table.

PARIS

Academy of Sciences, February 20.—M. Jamin in the chair —The following papers were read:—Meridian observations of small planets at Paris Observatory during the last quarter of 1881, by M. Mouchez.—On some applications of the theory of elliptic functions, by M. Hermite.—Double salts of mercury, by M. Berthelot. This relates to double iodides and chloroiodides. —Note on permanganate of potash considered as an antidote of snake poison, *apropos* of a publication of M. de Lacerda, by M. de Quatrefages. Vipers abound in Haute-Marne and some other departments in France (as is proved by the large numbers killed in consideration of a small premium on each viper). While the larger animals often recover from a bite, goats, sheep, and dogs often succumb. The effects on man, too, may be serious and even fatal. M. de Quatrefages desires the new method (some details of which he gives) to be made known. He also suggests it might be of use against the diseases treated by M. Pasteur.—Researches on a special influence of the nervous system causing the stoppage of exchanges between the blood and the tissues, by M. Brown-Séquard. Lesion of almost any part of the nervous system will cause this stoppage, which is more pronounced the more sudden the cause. The effects are chiefly these:—the venous blood becomes like arterial in colour; it holds less carbonic acid than normally; there are no convulsions before death; the body-temperature falls; the blood-vessels contract: after death, blood is found in the left heart, and the properties of the spinal cord, nerves and muscles, persist.—Action of high atmospheric pressures on the animal organism, by M. de Cyon. To M. Bert's apparatus he added arrangements for measuring the variations of blood-pressure, pulsations, and respiratory movements, and for stimulating sundry nerves. He finds that oxygen is not a special poison for the organism; animals die at high atmospheric pressures, simply because, the carbonic acid (the chief excitant of the vasomotor and respiratory centres), diminishing considerably, circulation and respiration stop; the former, because of too great lowering of blood-pressure; the latter, because of apnea. The heart-beats are accelerated for the same reasons; the oxygen increasing the action of the accelerating nerves, while the moderating action of the pneumogastric is lessened through failure of carbonic acid.—On the parasite of malaria, by M. Richard. This has been called by M. Laveran, *Oscillaria malariæ*. M. Richard has traced its development, in the red corpuscles, into a collar of dark granulations (displacing the hæmoglobin). Escaping, it appears like a flexible rod or whip; the thin end sometimes gets caught, and the organism then oscillates violently as if to free itself. In about an hour it dies. Generally, however, the parasite is inert. The parasitiferous corpuscles lose elasticity and become very viscous; hence they accumulate in the capillaries.—A new apterous male in Coccidians (*Acanthococcus auris*, Sign.), by M. Lichtenstein.—Observations of comet b = III. 1881, at Paris Observatory, by M. Bigourdan.—On the distribution of protuberances, faculæ, and solar spots, observed at Rome during the second and third quarters of 1881, by M. Tacchini. The faculæ extended to higher latitudes than in the first quarter; and protuberances were observed nearer the poles. In winter and summer a preponderance of protuberances appear in the south; in spring and autumn, in the north.—Solar spectroscopic observations at the Royal Observatory of the Roman College during the second and third quarters of 1881, by M. Tacchini. A continuous increase (not very rapid) of solar activity is indicated. In July the protuberances showed a secondary minimum, and the spots a maximum, and M. Tacchini attacks M. Faye's doubts as to this.—On the distribution, in the plane, of roots of an algebraic equation, of which the first member satisfies a linear differential equation of the second order, by M. Laguerre.—On the theory of uniform functions of a variable, by M. Mittag-Leffler.—On the integration of the equation $A\frac{d^n\phi}{dt^n} + \left(\frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \ldots\right)^n \phi = 0$. —On the practical solution of the problem of transport of force to great distances, by M. Levy. He proposes to have n generators connected in quantity, placed in n branch circuits, all connected with two points taken arbitrarily in the principal (biflar) circuit.—On the relative motion of the earth and the ether, by Mr. Michelson.—Compass without resistance, for measurement of intense currents, by MM. Terquem and Damien. This consists of a land-surveyor's compass, under which is a first band of copper for circulation of a current; under this a series of rectangular pieces of wood and other copper bands, the whole borne on a central rod. Two vertical bands bring the current into any one of the horizontal ones, according to the position in which you fix a peg.—Hydrodynamic experiments, &c. (continued), by Decharme.—On the saturation of phosphoric acid by bases and on chemical neutrality, by M. Joly.—On ferricyanhydric acid, by M. Joannis.—Action of iodine on naphtaline at a high temperature, by MM. Bleunard and Vrau.—On the blue and green coloration of dressings, by M. Gessard. He isolated the organism which produces the blue pigment (pyocyanine), and afterwards changes it to green.—Troubles of equilibration in young children deaf through otopiesis; their disappearance on return of hearing, by M. Boucheron.—On the evolution of teeth of Balænides, by MM. Pouchet and Chabon.—On the optical properties of crystalline bodies presenting the spherolithic form, by M. Bertrand.—M. Mouchez made some remarks on presenting a magnetic map of Russia by Col. de Tillo.

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